BULLETIN OF THE IMPERIAL INSTITUTE

A RECORD OF PROGRESS RELATING TO AGRICULTURAL, MINERAL AND OTHER INDUSTRIES, WITH SPECIAL REFERENCE TO THE UTILISATION OF THE RAW MATERIALS OF THE DOMINIONS, INDIA AND THE COLONIES

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Reported Missing

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Killed in Action

Air Gunner R. C. WILSON, Royal Air Force.

Obituary—Mr. J. J. Endcox.

It is with very great regret that we record the death on January 7, 1946, of Mr. J. J. Endcox. He joined the staff of the Imperial Institute as Assistant Statistician in 1926 when the Imperial Mineral Resources Bureau, with which he had served since 1923, was amalgamated with the Imperial Institute.

He was promoted to the post of Statistician in 1937, and discharged his duties with outstanding accuracy and reliability.

In 1942, owing to shortage of staff, he undertook the additional duties of Acting Secretary to the London Advisory Committee for Rubber Research, a post which he retained to his death.

He was a man loved and respected by his many colleagues to whom the news of his death has come as a great shock.

Retirement of Mr. F. Henn.

It was with mixed feelings that the staff said good-bye to Mr. Henn on February 25 on the occasion of his retirement at the age of 65 from the service of the Institute. Mingled with the natural regret that normally accompanies the departure of a colleague, is the knowledge that he is able to enjoy a spell of well-earned leisure from departmental duties.

Mr. Henn joined the staff of the Imperial Institute in 1898 after having spent about three years at the Kensington Public Library. The whole of his 47 years' service at the Institute, with the exception of about one year, he has spent in the Library, having worked his way up from the junior post until he reached the position of Librarian in 1926. During his many years he has seen the Library grow from a small beginning until it has reached its present-day dimensions. This development and the improvement of the library service are in no small measure due to his efforts, initiative and enterprise.

Mr. Henn will be remembered, not only by the staff, but also by the many visitors to the Library for his unfailing courtesy and helpfulness. Nothing was too much trouble to him while the unending request for books and periodicals always left his natural serenity undisturbed and his good temper unruffled.

BULLETIN
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PLANT AND ANIMAL PRODUCTS

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the Reports made to the Dominion, Indian and Colonial Governments

LEMON OILS FROM PALESTINE

By H. T. Islip, B.Sc., F.R.I.C. and F. Major, B.Sc., A.R.I.C.

In July 1944 the Imperial Institute was asked by a technical consultant in London for the analytical constants of genuine and typical Palestine lemon oil. No samples of the oil had been examined at the Institute, and since a search of the literature failed to disclose analyses of authentic samples of this oil, the Director of Agriculture and Fisheries, Palestine, was asked to supply the information required. He replied that he could obtain no first-hand data on local lemon oil definitely known to be genuine, and, therefore, in accordance with a proposal made by the Imperial Institute he was arranging for samples of oil from the 1944-45 crop to be forwarded to the Imperial Institute for analysis.

These samples of oil, from six different producers, were duly forwarded in March 1945 and examined at the Imperial Institute in April-May 1945. Later, September 1945, the oils were re-examined to ascertain whether any significant changes in the composition of the oils had taken place in the meantime. Between the two examinations the samples had been stored in the dark in their original bottles, but as during this time the bottles were only partly filled an opportunity for oxidation undoubtedly existed, which would not have been the case under normal conditions of storage.

The results provide useful data as guidance in dealing with Palestine oils, but until a greater number of samples has been examined no attempt is made to define the range of constants for oils from this source. Arrangements have been made for further

samples to be collected in Palestine and examined at the Institute, and the results will be published in due course.

Description

Sample 1125 consisted of 11 oz. of a clear, very pale yellow oil.

Sample 1126.—9 oz. of oil which was somewhat turbid owing to the presence of a small amount of insoluble matter, the clear filtered oil being brownish-yellow in colour with a greenish tinge.

Sample 1127.—8½ oz. of oil similar in colour to Sample 1125, but slightly opalescent owing to the presence of a very small amount of insoluble matter.

Sample 1128.—10 oz. of a clear, yellowish-brown oil.

Sample 1129.—10 oz. of a clear, pale yellow oil.

Sample 1130.—14 oz. of a very slightly opalescent, very pale yellow (almost colourless) oil.

All the above oils had a pleasant lemon-like odour which was, however, quite distinct from that of Sicilian lemon oil. The flavour, too, was different from that of the Sicilian oil, being more bland in type.

Results of Examination

The oils were filtered through paper before examination and the results obtained in the two series of examinations are shown in the accompanying table in comparison with the British Pharmacopoeia requirements for oil of lemon, and also with recorded constants for Sicilian oil :

Remarks

From the results of the examination of these six Palestine lemon oils it will be seen that, when examined in April-May 1945, they met the requirements of the British Pharmacopoeia in all respects except the following. The optical rotation was higher in every case than that allowed. The differences ranged from 0·8° for samples 1125 and 1128 up to 4·5° for sample 1127. Sample 1128, besides having an optical rotation which was slightly too high, contained more non-volatile matter than is permitted by the above authority ; and in this respect differed from the other five of this series. This difference may be due to the oil having been prepared by a process (i.e. Bennett's) which was not employed in the case of the other samples.

The amount of citral in all these six lemon oils fell into line with the requirements of the Pharmacopoeia, but it will be noticed in each case that the figure was below the minimum of the ranges for Sicilian lemon oil quoted by Gildemeister and by Parry. The optical rotation of the Palestine oils was generally higher than that of Sicilian oils. The odour and flavour of Palestine oils were different from those of Sicilian oils.

Considering the figures obtained in September 1945, it will be

CONSTANTS OF PALESTINE LEMON OILS

Sample Number. How prepared	PRESENT SAMPLES.												Comparative figures.		
	1125 Hand-pressed		1126 Machine-pressed		1127 Hand-pressed		1128 Machine-pressed		1129 Hand-pressed		1130 Hand-pressed		Requirements of the B.P. (1932), as amended by Addendum No. 7.	Range of constants for Sicilian Lemon Oil.	
	(a)	(b)	(a)	(a)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)		(1)	(2)
Specific Gravity at 15·5°/15·5° C.	0·8558	0·8587	0·8548	0·8615	0·8548	0·8657	0·8567	0·8572	0·8556	0·8609	0·8556	0·8576	0·855–0·861	0·856–0·861	0·854–0·862
Optical Rotation α_D 20° C.	+65·8°	+65·5°	+66·4°	+65·5°	+69·5°	+68·0°	+65·8°	+65·9°	+67·1°	+66·6°	+68·2°	+68·1°	+57° to +65°	+57° to +61°	+54° to +66°
Refractive Index n_D 20° C.	1·4752	1·4756	1·4751	1·4754	1·4750	1·4762	1·4752	1·4750	1·4757	1·4752	1·4751	1·4747	1·474 to 1·476	1·474 to 1·478	1·4745 to 1·4760
Citral *per cent.*	3·3	2·9	2·9	2·0	3·3	2·2	3·2	3·0	3·2	2·5	3·1	2·8	Not less than 2·5 per cent. w/w of aldehydes calculated as citral	3·5 to 5·0	4 to 6
Non-volatile matter, *per cent.*	1·9	1·8	2·2	2·5	1·8	2·7	3·4	3·4	2·1	2·6	1·8	1·8	1·5–3	—	2 to 6

(*a*) *Original examination* (*April-May* 1945). (*b*) *Re-examination* (*September* 1945)

(1) " *Die Aetherischen Oele,*" *Gildemeister & Hoffman, Vol.* III, *pp.* 34-36.

(2) " *Essential Oils,*" *Parry, Vol.* I, *p.* 398.

observed that a definite increase in specific gravity had been brought about by storing the samples, though in the case of sample 1128 this increase was very small, and that the specific gravity of sample 1127 had risen above the British Pharmacopoeia maximum for this constant. The optical rotation of the oils was somewhat lower than when the measurements were made originally, though still above the maximum given in the British Pharmacopoeia. Little change had taken place in the refractive index of the samples, which in every case still conformed to the British Pharmacopoeia requirements. The amount of non-volatile matter in sample 1127 was considerably in excess of that found previously and with sample 1129 an increase had taken place, though to a less extent; sample 1128, with 3·4 per cent., the same amount of non-volatile matter as before, was still the only oil having non-volatile matter in excess of the amount permitted in the British Pharmacopoeia. With regard to citral content, except in the case of sample 1128, a considerable drop in this constituent had taken place, with the result that samples 1126 and 1127 contained less than the 2·5 per cent. minimum specified in the British Pharmacopoeia.

It seems clear from a comparison of the results obtained in April-May 1945 with those obtained in September 1945 that, apart from sample 1128, the composition of the samples changed materially during the interval between the two examinations. It is well known that lemon oil is highly susceptible to oxidation; if the clear, dry oil is stored in full containers in the dark little change takes place, but with access of air oxidation may take place rapidly. Admittedly, in the present instance, after the examination had started, the best conditions for storage (apart from being in the dark) were not present, and some oxidation was only to be expected. It is rather surprising, therefore, to find that sample 1128, a rather dark-coloured, machine-pressed oil, stored in the same way as the other samples, should have altered so little.

ALEURITES MONTANA FRUITS FROM THE SUDAN

By F. Major, B.Sc., A.R.I.C.

For many years past the Imperial Institute, through its Consultative Committee on Oils and Oilseeds, has been engaged on the encouragement of the production of tung oil in the British Empire, and has, in conjunction with the Royal Botanic Gardens, Kew, instigated the carrying out of experimental cultivation trials with these trees in various parts of the Empire where climatic and other conditions appeared suitable. In this connection a large quantity of tung seed was distributed.

From time to time the Imperial Institute has received samples of the fruits produced in these experimental trials and has examined

them with a view to determining their oil content and the characteristics of the oil obtained from them. The results obtained for a number of these samples have already been published in this BULLETIN, 1932, **30**, 271; 1933, **31**, 327; 1937, **35**, 147.

In August 1945 a sample of *Aleurites montana* fruits was received at the Imperial Institute from the Trade Representative of the Sudan Government in London. It was stated that the fruits had been gathered from trees growing in Kagelu, which had been raised from seed originally supplied by the Imperial Institute. These fruits were examined in order to compare their composition and commercial value with similar material from other sources.

The sample, which weighed 2 lb., consisted of five whole fruits, the remainder being in the form of segments. The appearance of the fruits was typical of that of *Aleurites montana*. Each whole fruit contained three segments, each segment one nut, and there were no loose nuts or empty segments present in the sample.

Results of Examination

The sample was examined with the following results, which are shown in comparison with figures obtained at the Imperial Institute for samples of *A. montana* fruit and nuts grown in various countries.

	Present sample	*A. montana* fruits and nuts previously examined at the Imperial Institute.		
		Range of figures.		Average for all samples.
		For all samples.	For most samples.	
Fruits—				
Average weight in grams	11·8	8·2–22·0	15·5–19·3	16·1
Number of nuts in a fruit	3·0	1·7– 4·0	2·5– 3·0	2·8
Nuts . . . *per cent.*	41·5	31·4–51·5	39·0–49·0	42·7
Husk . . . "	58·5	48·5–68·6	51·0–61·0	57·3
Oil . . . "	12·8	9·4–19·1	12·0–17·0	14·3
Nuts—				
Average weight in grams	2·4	1·2– 4·3	2·5– 3·1	2·7
Kernels . . . *per cent.*	55·8	51·1–65·2	53·0–62·0	57·9
Shell . . . "	44·2	34·8–48·9	38·0–47·0	42·1
Oil . . . "	30·8	23·9–41·5	31·5–38·5	31·5
Kernels—				
Average weight in grams	1·4	0·7– 2·0	1·4– 1·7	1·5
Moisture . . *per cent.*	4·7	—	—	—
Oil in kernels as received "	55·2	44·0–66·6	55·2–62·2	57·8
Oil expressed on moisture-free kernels . . *per cent.*	57·9	45·9–69·5	59·0–65·0	60·9

The oil as extracted from the kernels with light petroleum was a somewhat viscous, golden-yellow coloured oil. The results of the examination of this oil are shown in the accompanying table in comparison with results obtained at the Imperial Institute for samples of oil prepared from *A. montana* kernels at the Imperial Institute and elsewhere, and also with British Standard Specification 391-1936 Tung Oil, Type F, as amended by War Emergency Revision (1940) applied to Tung oil from *A. montana*.

ALEURITES MONTANA FRUITS FROM THE SUDAN

	Present Sample.	*A. montana* oils previously examined at the Imperial Institute. Range of figures. For all samples.	For most samples.	Average for all samples.	Requirements of B.S.S. 391-1936 War Emergency Revision (1940) applied to *A. montana* oil.
Colour. Lovibond Colour scale (1 in. cell) Red units	2·5	0·5–3·8	1·0–1·8	1·4	Not darker than an agreed sample.
Yellow units	37·0	3·0–50·0	11·0–20·0	19·2	
Specific Gravity 15·5°/15·5° C.	0·9402	0·9379–0·9418	0·9379–0·9410	0·9395	0·934 to 0·943
Refractive Index n_D 20° C.	1·5130	1·5127–1·5190	1·5130–1·5174	1·5160	1·516 to 1·522
Iodine Value (Wijs, 1 hr.) *per cent.*	160·0	155·6–170·0	159·0–167·5	163·6	155 to 175
Saponification Value	190·5	191·5–194·5	191·5–193·0	192·7	189 to 195
Acid Value	0·6	0·3–15·0	0·3–1·3	1·9	Not exceeding 7 unless otherwise agreed.
Unsaponifiable Matter *per cent.*	0·3	0·3–0·7	0·4–0·7	0·5	Not exceeding 1 per cent.
Heat Test (276° C.) mins. (B.S.S.)	21	11·0–27·25	17·0–27·0	20·5	Not exceeding 16 mins. or in the same period as an agreed sample.
Heat Test (290° C.) mins. (Paint Research Station)	14¾	9·5–17·5	10·5–16·5	13·1	No range stated in specification.
Extractive *per cent.*	37·6	22·7–44·1	22·7–39·2	30·2	No range stated in specification.

Remarks

Comparing the weight and composition of the present sample of *A. montana* fruits from the Sudan with the results of examination at the Imperial Institute of previous samples from elsewhere, it will be observed that, although the figures fall within the range of all previous samples, the fruits are rather lighter in weight than the average and contain less oil. The same remark applies to the nuts and kernels of the present sample.

With regard to the oil extracted from the kernels, with the exception of the saponification value, which is a little lower than that of any sample of *A. montana* oil so far examined at the Imperial Institute, all the constants fall within the range of most of the samples of this oil previously examined. The oil conforms to the requirements of British Standard Specification 391-1936, War Emergency Revision (1940) as applied to *A. montana* oil, in all respects except the refractive index and the heat test.

The amount of extractive in the polymerised oil, although falling within the range of most of the samples examined at the Imperial Institute, is higher than is desirable; a high amount of extractive may possibly be due to the fruits not being fully developed.

There is little doubt, however, that oil of similar quality would find a ready market in the United Kingdom at the present time.

PYRETHRUM FLOWERS FROM ST. HELENA

By F. MAJOR, B.Sc., A.R.I.C.

KENYA as a commercial source of pyrethrum flowers is well known and the product from this colony of the British Empire occupies to-day the premier position. In other Empire countries cultivation trials have been carried out with pyrethrum during the past decade. Samples of flowers grown in Tanganyika, Ceylon, St. Helena and Nigeria have been examined at the Imperial Institute and the results of the examination have already been published in this BULLETIN, 1940, **38**, 158; 1945, **43**, 7.

Recently a further sample from St. Helena has been received at the Imperial Institute through the Colonial Office, where it had been sent by the Agricultural Officer, St. Helena, with a view to its being evaluated.

The sample consisted of 6 lb. of dried inflorescences in good condition, the majority of which appeared to have been gathered at the correct stage of development; the flowers were rather small in size. There was, however, present in the sample a small number of flowers which had been harvested when in too mature a condition, and had in consequence lost some of their disc florets and were somewhat darker in colour than is considered desirable.

On chemical analysis the sample furnished the results given below, which are shown in comparison with those obtained for

samples of pyrethrum flowers from St. Helena previously examined at the Imperial Institute (see this BULLETIN, 1940, **38**, 161).

	Present Sample.	Previous Samples.	
		1939	1937
	per cent.	per cent.	per cent.
Moisture	8·5	10·0	8·6
Pyrethrin I	0·68	0·45	0·46
Pyrethrin II	0·54	0·59	0·56
Total Pyrethrins	1·22	1·04	1·02

Pyrethrin I was determined by means of Martin and Brightwell's modification of the Wilcoxon-Holaday method using a factor of 5·7 ; Pyrethrin II by the Seil method. For the previous samples the Seil method was used for both pyrethrins.

The chemical examination of the present sample of pyrethrum flowers shows them to contain a satisfactory amount of total pyrethrins, the figure being somewhat higher than that obtained with the previous samples from St. Helena and only slightly inferior in this respect to Kenya-grown flowers which are usually sold on a guaranteed total pyrethrin content of 1·3 per cent.

Remarks

Pyrethrum flowers having a total pyrethrin content similar to the present sample should be readily saleable in the United Kingdom. At the present time all dealings are controlled by the Ministry of Supply, the price to the user being 1/9 per lb. for flowers containing 1·3 per cent. total pyrethrins. Based on this figure the price the Ministry would charge for flowers of the quality of the present sample would be 1/7½ per lb.

PATCHOULI OIL FROM NYASALAND

By H. T. ISLIP, B.Sc., F.R.I.C.

THE sample of patchouli oil which is the subject of this report was received from a planter in Nyasaland in May 1945. It was stated that the oil had been distilled from plants grown from cuttings obtained from the Seychelles three years before.

It was desired to ascertain the commercial value of the oil and whether it was identical with the Seychelles product.

Results of Examination

The sample, which amounted to about 16 fl. oz., had the characteristic aroma of patchouli oil, with a distinct camphoraceous subsidiary odour. The oil was somewhat turbid owing to the presence of moisture, and after filtration through paper the clear oil was brownish-yellow in colour.

On examination the clear, filtered oil was found to have the following constants, which are shown in comparison with the

range of corresponding figures obtained at the Imperial Institute for normal samples of patchouli oil from the Seychelles and with those recorded by Parry[1] for commercial patchouli oils from Singapore :

	Present Sample.	Samples from Seychelles.	Singapore Oils (Parry).
Specific Gravity, 15·5/15·5° C.	0·9662	0·940 to 0·970	0·955 to 0·980
Optical Rotation, α_D 20° C.	−55·76°	−39·6° to −55·6°	−44° to −62°
Refractive Index, n_D 20° C.	1·5089	1·502 to 1·510	1·5065 to 1·5130
Acid Value	0·7	0·3 to 3·2	0 to 1
Ester Value	1·1	0 to 5·3	1·5 to 8
Solubility in 9[illegible]er cent. v/v alcohol at 15·5° C.	Soluble in 9 vols. with opalescence.	Soluble in 0·5 vols. to not soluble even in 12 vols.	Soluble in 3 to 10 vols.

The foregoing results show that the present sample of patchouli oil from Nyasaland had constants falling within the ranges of figures obtained at the Imperial Institute for normal patchouli oils distilled in the Seychelles. The ester value is very slightly below the lower limit recorded by Parry for Singapore patchouli oil.

Commercial Value

The oils were submitted to two firms of essential oil distillers and one firm of essential oil importers, all in London, who furnished the following reports respectively :

(1) " We have carefully examined the sample of Nyasaland patchouli oil. The figures agree very closely with those for the Seychelles and the odour of the oil is also similar, rather smoother, but not so powerful as that from the Seychelles. We are of the opinion that it can be generally used in place of the Seychelles oil, but it might command a slightly lower price."

(2) " The oil possesses a slight camphoraceous note, but I consider the odour value slightly superior to Seychelles oil. It would find a use in soap compounds and for general purposes in which patchouli oil is indicated.

" The value of Seychelles oil pre-war was about 12/- per lb. rising during the war from 32/- per lb. in 1940 to 65/- per lb. in 1944. It is therefore very difficult to give a forecast of what the value of this oil would be over say the next five years, but at an intelligent guess I should indicate a price of round about 20/- as one on which to base economics of production. I do not think it would be safe to take a higher value, although of course, if supplies were available now it would command at least 40/- to 50/- per lb. Once the market gets " saturated " with an oil the price tends to fall, but there has been such a

[1] *Essential Oils.* Parry, Vol. 1, p. 245.

shortage of patchouli for some years that the market will take a good deal of 'saturating.'

"As mentioned above, if the Nyasaland oil is of a quality equal to the sample we have received there will be no difficulty in placing it in competition with other sources."

(3) "We have examined this oil and have also submitted samples to one or two of our friends. The conclusions reached are that it compares most unfavourably with the Singapore patchouli oil, it lacks body and fulness, and although the patchouli odour is there it is very thin and terpenic. By comparison with the Seychelles patchouli oil the inferiority is not quite so marked, but it does nevertheless fall short in strength and odour. One opinion expressed is that the oil has possibilities but not as a replacement of either Singapore or Seychelles oil. It occurs to us, however, that the oil might be improved if different methods of preparing the leaves for distillation were used, but we do not feel competent to advise on this point . . .

"We referred above to an opinion that the Nyasaland patchouli will not replace the Seychelles and Singapore oils in normal times; these are not normal times, however, the supplies of patchouli from the Malay States and Dutch East Indies are cut off, we do not know when these places will be liberated nor the state of the plantations. The production in the Seychelles is extremely limited and the demand for Patchouli considerable, in these circumstances we have little doubt that a market for the Nyasaland patchouli could be found, but until trial consignments have been received and used in actual production it is extremely difficult to put a value on it. Recently Seychelles patchouli oil has fetched as high as 160/- per lb. f.o.b. This is, of course, a most abnormal figure and the producers in Nyasaland would be well advised to bear in mind the fact that prior to the war when the Malay States, the main source of patchouli oil, was available the price varied between 5/6 and 18/6 per lb."

Remarks

The results of this investigation indicate that the present sample of patchouli oil from Nyasaland is similar in composition to Seychelles patchouli oil. Regarding the commercial value of the oil opinions differed somewhat as to the relative merits of the Nyasaland oil compared with the Seychelles product. There is little doubt, however, that under the present very abnormal conditions the oil would find a ready market in this country, and even in normal times oil of similar quality would be marketable at prices comparable with, though probably somewhat lower than, those obtaining for the Seychelles oil.

NOTES

Oiticica Oil.—Oiticica oil is obtained from the seeds of *Licania rigida* Benth. (N.O. Rosaceae), a tree which is indigenous to Brazil. The tree occurs, often growing in dense stands, over a wide area in the north-eastern part of this country, principally in the states of Ceara, Piauhy, Parahyba, Rio Grande do Norte and Pernambuco. It grows especially along the banks of streams and in the lowlands and although quite able to resist drought, it usually gives a higher yield of fruit in the moister areas of relatively dry regions. The tree is rather slow-growing and often reaches 75 to 100 ft. The yield of seed per tree is estimated at from 1-1½ cwt. per annum. No serious attempts have apparently been made to cultivate the tree systematically in Brazil, the entire source of the seed being wild trees. Research is, however, being carried on at a Government station in the State of Parahyba. Efforts are being made to adapt the oiticica tree to soils other than alluvial. Grafting experiments are also being made. It is hoped that the outcome of this research will be the selection and cultivation of high-yielding trees, the introduction of plantation methods and the control of insect pests.

Several plantings have been made in the West Indies but as far as information is available no fruit has been produced. This may be due to the slow-growing habit of the tree. It is said to take at least seven years before it starts producing fruit. To prevent the establishment of plantations outside Brazil the export of seeds for propagation purposes is forbidden by the Brazilian Government.

The fruits start to ripen in January, when harvesting commences, and continue to do so to April. When gathering the fruits the natives adopt the primitive method of removing them from the trees by shaking or by means of sticks and stones, as well as picking up those already fallen. The fruits are roughly ovoid in shape, and from 1 to 2½ in. long and from ½ to 1 in. in diameter. They consist of a reddish-coloured kernel covered with a thin shell. Their composition is 28 to 30 per cent. of shell and 70 to 72 per cent. of kernels. The kernels contain from 60 to 65 per cent. of oil. It is cream-coloured, viscous and semi-solid at ordinary temperatures. The oil is prepared either by expression or by solvent extraction. When first expressed oiticica oil is quite liquid, but it sets to a soft pasty mass on storage. This phenomenon is governed chiefly by temperature only. Special treatment involving high temperatures is said to eradicate permanently the tendency to solidify. Its conversion into a light stand oil by treating at 225° C. for about 45 minutes is also said to prevent solidification. Much of the oil exported from Brazil has been given before shipment a preliminary heat treatment to keep it liquid.

According to the Tentative Specification (D601-41T-1941) of the American Society for Testing Materials, oiticica oil (permanently liquid) should fulfil the following requirements :

Specific Gravity at 15·5° C.	0·978 (min.)
Refractive Index at 25° C.	1·5100 (min.)
Iodine Value	135 (min.)
Acid Value	8 (max.)
Viscosity, poises	18 (min.)
Heat Test, minutes	17 (max.)
Colour (Gardner 1933) Standards	11 (max.)
Matter insoluble in chloroform *per cent.*	0·1 (max.)

The chief glyceride present in this oil is that of α-licanic acid.

Oiticica oil is largely used in the manufacture of varnishes. It dries more rapidly than any of the other usual commercial natural varnish oils with the exception of tung oil. In the raw condition it suffers from the defect of wrinkling on drying. A considerable amount of research work has been carried out on oiticica oil to determine the best methods of processing it to obtain the most suitable product. Such a medium has been produced. At first it was believed that oiticica oil could be used as a direct substitute for tung oil, but time has shown that it has its own properties and is not another tung oil.

In normal times oiticica oil commands a price between those of linseed and tung oils. Its use has increased considerably during the last 10 years. It came into prominence during 1914-18 but then the demand for it disappeared for a number of years. In 1935 this oil regained its importance as a varnish oil.

The quantities of oiticica oil exported from Brazil during recent years were :

Year	1,000 Kilos
1934	88
1935	1,655
1936	3,293
1937	1,521
1938	3,717
1939	9,284
1940	7,235
1941	16,606
1942	1,076
1943	972
1944 (six months)	718

By far the greater proportion of these exports went to the United States.

Bibliography

Eisenschiml, G., *Oil, Paint and Drug Reporter*, 1941, **139**, No. 10, 32C.
Holdt, C. P., *National Paint Bulletin*, 1937, **1**, No. 4, 10.
Rudd, H. W., *Paint*, 1940, **10**, 99.
W.B., *International Review of Agriculture*, 1942, **33**, 45T.
Small, W. N., *Foreign Commerce Weekly*, 1942, **8**, No. 2, 10.
Gardner, H. A., *Nat. Paint Varn. Lac. Assoc., Sci. Sect., Circ. No.* 470 (1934).
Anon., *Ibid., Circ. No.* 495 (1935).
Gardner, H., and Scofield, F., *Ibid., Circ. No.* 602 (1940).
Anon., *Paint and Varn. Prod. Man.*, 1942, **22**, 234, 236.
Anon., *Oil and Soap*, 1942, **19**, 140.
Anon., *Bull. Imp. Inst.*, 1929, **27**, 279.

G.T.B.

Cashew Nut Shell Oil.—Cashew nut shell oil occurs in the soft honeycomb structure between the outer shell and the kernel of the nuts of the cashew tree (*Anacardium occidentale*) which occurs in India, Portuguese East Africa, Brazil, British East and West Africa, Ceylon, the West Indies and the Philippine Islands.

So far as can be ascertained cashew nut shell oil is only prepared commercially in India, although the possibility of its production in Brazil has recently been under consideration. In India the oil is won not only from locally grown nuts but also from nuts imported mainly from Portuguese East Africa. It is interesting to note that in 1940 about 400 tons of nuts were imported into India from Brazil.

The concentration of the production of cashew nut shell oil in India is a natural corollary of the establishment there of modern methods of packing cashew kernels in inert gas for the American market. The nuts are difficult to crack unless they are first subjected to a heat treatment, either by roasting in pans over an open fire as in the ordinary native method, or by means of special plant as in the modern factory method. In either case the oil is released by the heat and is collected. The recovery of the oil is thus incidental to the extraction of the kernels and a large wastage of oil is inevitable during the roasting. Records of the amount of oil in the fresh shell range from 29 to 35 per cent. but the normal yield is only from 12 to 15 per cent. In the newer methods a larger recovery is effected.

The actual quantity of shell oil produced in India is not published and statistics of exports of the oil are not recorded. According to M. T. Harvey and S. Caplan of the Harvel Research Corporation (an American concern which has been mainly responsible for the development of new industrial uses for the oil) by efficient extraction methods 29,000,000 lb. of shell oil should be available in India for commercial purposes yearly. This estimate is based on the assumption that the weight of shell is equal to the weight of kernel in the nut, that 50 per cent. of the available oil is recovered and on the quantity of shelled kernels available for shipment in 1938, which is put at 58,000,000 lb. This figure may be on the high side for the actual quantity of kernels exported from India in 1937-38 and 1938-39, according to the official trade returns was 12,745 and 13,499 tons respectively, i.e. only about one-half their figure.

The possibility of preparing the oil has been considered in several countries. For example, it was reported that in view of the shipping difficulties between India and the U.S.A. M. T. Harvey of the Harvel Research Corporation visited Brazil in 1941 in order to investigate the prospects there. The results of the mission do not appear to have been made public, but it is said that large quantities of the nuts, which at present go to waste, could be collected if the Brazilian Government could be induced to organise the industry.

Cashew nuts occur in a large number of Empire countries. In

addition to the East African territories they are produced in Ceylon, the West Indies and West Africa. Some of these have already looked into the possibility of producing the shell oil and samples produced experimentally in Ceylon and Trinidad have been examined at the Imperial Institute, whilst it is said that in 1936 a factory was planned for the annual production of 200,000 gallons of the oil in Nigeria. As already indicated, there has hitherto been no commercial production of the oil in any of these countries. Whether any of them will eventually start up an industry it is difficult to say. It is known that the composition of the oil varies according to the heat treatment to which the nuts have been subjected and to produce a uniform product it seems likely that the industry would have to be carried out on a factory scale, as is now the case to a large extent in India. But first and foremost success would be dependent on the market for the kernels and the supply of cheap labour for cracking the nuts, or alternatively the provision of an adequate cracking machine. The Trinidad Agricultural Society investigated this question of the kernels some years ago and came to the conclusion that owing to the cost of production they could not compete with India. The same may well be true of other parts of the Empire.

There are four main methods which have been suggested for obtaining the shell oil from cashew nuts. These are: (i) solvent extraction of the shells; (ii) roasting of the nuts—this is the native method; (iii) extraction of the nuts with hot cashew nut shell oil under conditions that will not char the kernels; and (iv) treatment of the shells with super-heated steam, a process sometimes used in conjunction with (iii) to improve the yields.

Among the methods included in group (iii) is the one which is the subject of a British Patent (No. 472,195 of 20/9/1937) taken out by W. Jefferies and Peirce, Leslie & Co. This patent covers not only the process, but also the design of a plant. Features claimed are the feeding of cashew nuts to a confined space below the level of shell oil in a bath and the continuous conveyance of the nuts in a single layer through the bath, thereby ensuring an approximately equal time of treatment for all the nuts.

The plant consists of a bath containing cashew nut shell oil, mounted over a double grate furnace. Inside the bath are fitted a curved fixed false bottom and an endless conveyor equipped with cross ribs. To obtain the shell oil the whole nuts are discharged periodically through a hopper at one end of the bath and are passed in a single layer between the fixed false bottom and the moving conveyor. In so doing the outer layer of the nuts containing the shell oil is removed, the liberated oil thereby becoming mixed with the shell oil in the bath. The space between the false bottom and the conveyor is about 1¼ in. The nuts after passing between the fixed and moving members leave the bath at the end opposite the one at which they entered above the level of the oil and are drained and

cooled. The oil in the bath is maintained at about 370-380° F. The rate at which the nuts pass through the plant is about 15 ft. in 80-90 secs. By passing the nuts in a single layer between the false bottom and the conveyor they are prevented from floating. Any frothing of the shell oil that may occur may by a suitable arrangement of the oil level in the bath be kept from leaking through the entrance and exit. Charring of the kernels is prevented by the uniform heating of the nuts. Moisture in the nut shells on being sufficiently heated effects the bursting of the shells with the consequent liberation of the oil. A moisture content in the nuts of from 7 to 10 per cent. gives the best results. If they do not contain this amount, the nuts may be wetted and stored in a heap prior to being immersed in the oil bath.

The same patentees have also devised a process and designed apparatus for the extraction of shell oil from cashew nuts using superheated steam (group iv). This process and apparatus may also be used as a supplementary treatment to the broken shells obtained by the method described above, and which may still contain from 10 to 15 per cent. of oil. In this process the nuts or shells are placed in large vertical containers connected with one another and super-heated steam at 500-700° F. and 5-20 lb. per sq. in. pressure is led in. By this treatment the unruptured cells are burst and the liberated oil rendered less viscous. Shell oil and condensed steam are drawn off from the bottom of the containers. Uncondensed steam passes from one container to the next. Treatment with saturated steam at the same pressure for 10 minutes may follow that with super-heated steam, which may last 1 hour.

Cashew nut shell oil is a dark coloured viscous liquid with poisonous properties. It has a strong vesicant and dermatitic action on the human skin. The main chemical constituents of the oil are a phenolic body, cardol (about 10 per cent.), and a second phenolic substance, anacardic acid (about 90 per cent.). In India cashew nut shell oil has for very many years been used for waterproofing purposes, such as for the treatment of the bamboo screens around verandahs. It is also employed in that country mixed with cement for flooring purposes. In the United States this oil has been used on a small scale industrially for a number of years but more recently both in that country and the United Kingdom interest in this raw material has considerably increased. One of its main uses is in the manufacture by polymerisation or other means of synthetic resins, which are employed either alone or with other materials in making numerous industrial products, such as insulating varnishes, typewriter rolls, oil- and acid-proof cold setting cements, floor tiles and brake linings. Resins prepared from this oil are stated to possess good resistance towards acids and alkalis.

The crude cashew nut shell oil as imported is first given by the manufacturer of resins an acid treatment to get rid of metallic impurities and to decompose the traces of sulphur compounds.

The resulting product may then be used as the raw material from which to prepare resins or it may be given a subsequent treatment, such as steam distillation whereby it is separated into two fractions. The yield of distillate is about 70 per cent. It contains a phenol, cardinol, which is derived from the anacardic acid, originally present. The portion, non-volatile in steam, contains cardol and a polymer formed during the treatment to which the cashew nut shell oil has been submitted.

Resins may be prepared from the treated oil, the volatile and the non-volatile products obtained on steam distillation. Several methods of preparation are in use. In some of these the material is given a preliminary acid treatment, e.g. with an alkyl sulphate, whereby polymerisation is effected. The polymerised product is then condensed with an aldehyde to give a range of resins with varying properties. In many cases, however, the condensation with aldehydes is effected without previous acid polymerisation. By this means a further range of resins is obtained. The use of products obtained from cashew nut shell oil, other than by aldehyde condensation, has also been investigated. For example, a certain higher ether has been widely used as a constituent of cable cloth varnishes, while an acid ether has been employed in the preparation of naphthenic acid driers and in alkyd resin manufacture.

BIBLIOGRAPHY

Patel, N. M. and M. S., "Cashew-nut Shell Oil and a Study of the Changes produced in the Oil by the Action of Heat." *J. Univ. Bombay*, 1936, **5**, Pt. ii, 1/4. Abst. in *Brit. Chem. Absts.*, 1937, B, 464.

Patel, N. M. and M. S., "Oil from the Shells of Roasted Cashew Nuts." *J. Indian Chem. Soc.* (*Industr. Ed.*), 1938, **1**, 83. Abst. in *Brit. Chem. Absts.*, 1938, B, 1322.

Sayed, I. A., "The Development of the Cashew-nut Industry in India." *Agriculture and Live-stock in India*, 1939, **9**, Pt. 1, 26.

Harvey, M. T., and Caplan, S., "Cashew Nut Shell Liquid." *Industr. and Engng. Chem.* (*Industr. Ed.*), 1940, **32**, 1306.

Backer, H. J., and Haack, N. H., "Components of the Latex of *Anacardium occidentale* Linn (Cashew Nut)." *Rec. Trav. Chim.*, 1941, **60**, 661. Abst. in *Amer. Chem. Absts.*, 1943, **37**, 1394.

Jordan, C. C., and Crone, D. R., "India's Cashew Industry." *For. Comm. Wkly.*, 1942, **8**, No. 6, p.4.

Anon., "Cashew Nut Shell Liquid." *Paint Technology*, 1943, **8**, 179.

Wasserman, D., and Dawson, C. R., "Cashew Nut Shell Liquid. A Comparison of the Monophenol isolated from Commercial Raw Cashew Nut Shell Liquid and from Commercial Cardanol." *Industr. and Engng. Chem.* (*Industr. Ed.*), 1945, **37**, 396.

Morgan, J. D., "Cashew Nut Shell Liquid (C.N.S.L.) Resins." *J. Oil Col. Chem. Assoc.*, 1945, **28**, 65.

Rossall Pye, C., and Parvin, K., "The Properties and Uses of Cashew Nut Shell Liquid." *Paint Technology*, 1945, **10**, 249.

Harvey, H. I., "A Review of the 15 British Patents on Cashew Nut Shell Liquid and Resins." *Paint Technology*, 1945, **10**, 289, 323.

G.T.B.

The Fish Liver Oil Industry of South Africa.—Although oil was being rendered from fish livers at Cape Town, Mossel Bay and Walvis Bay as long ago as 1860, it was only in 1936 that the scientifically controlled extraction of fish liver oils commenced.

The following particulars relating to this industry have been supplied to the Imperial Institute by the South African Bureau of Information.

In 1936 a research chemist, working on his own initiative and without outside financial backing at the University of Cape Town and in the laboratory of the Division of Fisheries at St. James, completed a survey of the Vitamin A content of liver oils obtained from species of fish caught locally in large quantities. At the same time methods of processing were evolved. By 1938 the scientific production of vitamin oils by modern methods was firmly established on a commercial basis. Progress has been maintained on the same level and to-day South Africa is supplying about one quarter of Britain's large requirements of Vitamin A for the fortification of margarine.

The industry is concentrated along the coast of the Cape Province. There are currently three major firms in the industry operating plants at Cape Town, Port Elizabeth, Walvis Bay, Simonstown, Gansbaai and Hout Bay. It is probable that other plants will soon come into operation. At Simonstown, Hout Bay and Gansbaai, production is concentrated almost entirely on the extraction of oil from the valhaai (*Galesrhinus canis*, Rond.), a shark which abounds in Cape Town. The three companies which concentrate on sharks operate their own boats, sturdy cutters with a range of several hundred miles. They also buy shark livers from the inshore fishermen, providing the latter with a useful source of revenue in the slack season. One of these companies has actually built its own fleet of " sharkers " capable of remaining at sea for a week at a time. At Cape Town and Port Elizabeth the industry looks to the trawlers for its supplies of raw materials, extracting oil from fish offal which was formerly jettisoned after the fish had been cleaned. One company annually buys as much as 500,000 lb. of offal at Walvis Bay and operates boats for the purpose of collecting this material from the fishing grounds.

Relatively little of the Union's production of vitamin oils is absorbed in South Africa. When the manufacture of margarine to alleviate South Africa's chronic butter shortage was mooted, the possibility did appear to exist that a large quantity of Vitamin A might be diverted to domestic use. Margarine production has been restricted, however, and the bulk of the vitamin oil goes overseas. A small quantity of oil is used for the manufacture of pharmaceutical preparations and these have been enjoying ready sale, comparing as they do more than favourably with imported products.

The Union Government has already demonstrated its interest in the industry through the Fisheries Development Corporation. This Corporation established last year to give effect to the new Fisheries Act introduced by the Minister of Economic Development, has made a careful study through its board of the possibilities of the vitamin oil industry. In the near future the Corporation

proposes to underwrite in part the activities of a new firm soon to start operations at Hout Bay. The industry will also benefit, in terms of the increased supplies of raw materials which will become available, when the activities of the Division of Fisheries are extended to the surveying and documentation of new fishing grounds. Already the total yield (in International Units) of Vitamin A from the South African fisheries far exceeds the total yield of the much larger Newfoundland fisheries and there is every reason to believe that vitamin oils will steadily bulk larger among the Union's exports. Besides its nutritional uses, fish oil is used extensively in industry, in soap manufacture, the making of paints, linoleum and waterproof fabrics, and in the leather industry.

The principal commercial species of fish landed in the Union have, as a general rule, large oily livers, whereas the fat content in the muscles is low. In the pilchard, on the contrary, the livers are small, and have little oil, whereas the muscle tissue is very oily. Thus our stock-fish yield up to 40 per cent. of oil, while the muscle tissue yields only about 1 per cent. The pilchard, on the other hand, contains up to 20 per cent. oil in the muscle tissue, but only about 5 per cent. fat in the liver. The fat or oil content of the tissues varies with the seasons and the state of sexual maturity and also in accordance with the immediate environment of the fish. Sharks (Elasmobranchii) have large and very oily livers. In most species of sharks the liver constitutes about 10 per cent. of the weight of the fish, while sometimes it is as high as 35 per cent. and the oil ranges from 25-80 per cent. The muscle tissue also contains a considerable amount of oil. The usual colour of dog fish livers is putty-grey, and these yield up to 80 per cent. of oil, but sometimes certain livers are of a dark colour with mottled patches, and these only yield about 40 per cent. of oil, although the Vitamin A content of this oil is always a great deal higher than that of the grey livers.

A number of processes are used in the preparation of fish liver oils but the most popular of the modern methods is the direct steam process. In this method the livers are placed in a large vessel into the bottom of which steam is injected. After the lapse of a certain period, water is forced into the vessel and the oil is allowed to drain away through a pipe. Water is separated from the oil, either by allowing the mixture to settle or more commonly by centrifugal means. The oil is then filtered and run into storage tanks. Sometimes the livers are treated with steam while under reduced atmospheric pressure.

The preparation of vitamin A and D concentrates is an important part of the production of fish oils, and the following are the principal methods employed: (*a*) saponification technique, which aims at separating the unsaponifiable matter from the original oil and then redissolving it in a vegetable oil such as cottonseed oil; (*b*) absorption methods in which the vitamins are absorbed on activated carbon or other absorbent materials and then washing

out the vitamins with some solvent such as toluene ; (*c*) molecular distillation method which distils out the vitamins at extremely high vacuums, the degree of the removal of the vitamins being controlled by mixing the oil with a dye having the same distillation curve as the vitamin which is being concentrated, so that when the dye is distilled off it is known that the vitamin has also been removed.

The relative potencies of South African fish liver oils are shown in the following table :

Species	International Units of Vitamin A per gramme.	International Units of Vitamin D per gramme.
Stock-fish	10,000— 12,000	200—300
Kingklip	10,000— 40,000	200—600
Kabeljou	25,000—200,000	—
Stonebass	100,000—600,000	—
Blue Shark	15,000— 30,000	—
Dogfish	4,000— 6,000	—
John Dory	20,000— 70,000	—
Halibut	— 50,000	1,000—2,000
Cod	1,000	100

From this table it is apparent that most of the liver oils produced from our commoner South African fishes have a much greater potency than cod-liver oil and many compare favourably with halibut oil.

During the last three years there has been published from time to time in the *Journal of the Society of Chemical Industry, London*, a series of papers under the general title of " South African Fish Products." These papers are of a comprehensive nature and have furnished a considerable amount of information concerning the oils obtained from South African fish.

BOOK REVIEWS

Books for review should be addressed to " The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

A NOTE-BOOK OF TROPICAL AGRICULTURE. Compiled by R. Cecil Wood, M.A., Dip.Agric.Cantab. Third Edition. Pp. 147, 7 × 4½. (Trinidad, B.W.I. : The Imperial College of Tropical Agriculture, 1945.) Price 10*s*. 6*d*.

This work was first published thirteen years ago, and since the second edition was prepared in 1937 the author, Professor Wood, has died, and the current volume now appears under the editorship of G. G. G. Unfortunately, neither the late author nor the present editor, as is perhaps more understandable in existing circumstances, has been able to make more than minor alterations to the initial

text. As originally issued this reference book promised to grow into an extremely valuable publication if gradually improved and expanded in subsequent editions. It seems rather a pity that such a steady development has not as yet been possible, and it is difficult in consequence to give the new issue more than a qualified welcome, especially at the relatively enhanced price of 10*s.* 6*d.*

In the review of the first edition (this BULLETIN, 1933, 31, 247) attention was drawn to the lack of balance in the important section devoted to crops. Cassava is still dismissed with the comment that it is "planted from cuttings," and many other crops deserve more adequate treatment. It would add to the value of the work to relate yield and other data to particular countries and circumstances. The relative commercial importance of individual species might be indicated, e.g. of the rubbers. Additional space might be obtained for expansion by reducing the number of inter-leaved blank pages; if the data were more complete there should be less need for a large number of these. More references to original papers on which statements are based would seem likely to add to the authority of the compilation.

It must be appreciated that the collection of material for a book of this nature involves considerable study. However, as a fully revised edition would seem likely to prove so valuable perhaps the desirable complete revision may one day be attempted.

E. H. G. S.

ARTS AND CRAFTS OF THE COOK ISLANDS. By Te Rangi Hiroa (Peter H. Buck). Bernice P. Bishop Museum Bulletin 179. Pp. 533, 10 × 7. (Hawaii: Bernice P. Bishop Museum, 1944.)

This publication, which is worthy of a more lasting form of binding, represents the results of a long and meticulous study of the culture of the people of the Lower Cook Group, which consists of the islands Rarotonga, Mangaia, Mauke, Mitiaro, Atiu, Takutea, Manuae and Aitutaki. This group and the Northern Cook Group were formally annexed to the British Empire in 1900, and are administered by a Resident Commissioner appointed by the New Zealand Government.

The author introduces his subject with a concise account of the people concerned, their language and history, and the geography of the country. This is followed by a systematic and thorough handling of all the economic, artistic and recreative exercises which are comprised in the comprehensive classification of arts and crafts. The industrial occupations considered in detail include fishing, horticulture, hunting, and the production of houses, clothing, ornaments, canoes, head-dresses, weapons and stone implements. Art, religion, games and recreation are also fully described. This highly interesting and valuable treatise ends with a discussion of the cultural processes which have taken place in the life of the islands, development from early origins, changes, deterioration and survivals

being traced. A final summing up of the present conditions in relation to the forces which have effected the course of evolution is well presented in the concluding pages. Throughout, the volume is generously illustrated with figures in the text, and at the end of the book there are numerous plates and a bibliography. J. R. F.

AN INTRODUCTION TO THE CHEMISTRY OF CELLULOSE. By J. T. Marsh, M.Sc., F.R.I.C., F.T.I., and F. C. Wood, Ph.D., F.R.I.C., F.T.I. Third Edition, revised. Pp. xi + 525, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Chapman & Hall, Ltd., 1945.) Price 32*s*.

The new and revised edition of this work follows very closely both the format and text of the second edition published in 1942 which was reviewed in this BULLETIN, 1942, **40**, 207. This previous review is still fully applicable to the third edition although there has been some slight rearrangement within some of the chapters and a general addition of new information, photographs and diagrams

Cellulose has now assumed such an important position in our economic life that a study of its constitution and properties is becoming a necessity to many and varied types of undertakings. It is therefore a pleasure to be able to recommend a book which by covering so many aspects of this subject in a relatively simple yet thorough manner, may be said to lay a firm foundation to the up-to-date knowledge required by the research worker and works chemist alike. H. E. C.

A DICTIONARY OF THE FUNGI. By G. C. Ainsworth, B.Sc., Ph.D., and G. R. Bisby, M.A., Ph.D. Second Edition. Pp. viii + 431, $7\frac{1}{4} \times 5$. (Kew, Surrey: The Imperial Mycological Institute, 1945.) Price 20*s*.

In this second edition of a most comprehensive and useful dictionary a number of changes and additions have been made. The first edition was reviewed in this BULLETIN, 1944, **42**, 101. Amongst the more important additions are the biographical notes which have been extended to cover about sixty important mycologists and the systematic arrangement of the genera of *Myxothallophyta* and *Eumyces*, which is a very welcome addition.

Professor G. W. Martin has made some changes in his key to the Families of Fungi, especially with regard to the classification of the *Phycomycetes* and *Ascomycetes*. A number of smaller changes have been made throughout the text. I. C. S.

MODERN FRUIT GROWING. By W. P. Seabrook. Seventh Edition. Pp. 307, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Ernest Benn, Limited, 1945.) Price 10*s*.

With the present edition this extremely useful and well-known textbook on fruit growing is now in its 25th thousand, it having

been originally published in 1918. This is essentially the work of the practical grower and embodies the views and experiences of many years in the industry. There is hence the tendency for the matter to be dogmatic. Nevertheless, it is the type of book that is invaluable to the fruit grower who will take Mr. Seabrook's teachings and adapt them to his own circumstances, and with reference to the opinions of other authorities. The author's constant theme on the subject of home-produced fruit is that only the highest possible standard will do. His book should certainly be studied by all commercial fruit growers, and is of value to all concerned with fruit.

The author sets himself to deal comprehensively with the problems of the grower: selection of land, capital required, preparation and planting, varieties, pruning, spraying equipment, grading, marketing, records, storage, labour, etc. Much useful practical information is contained, for instance, in the account of soil cultivation and manuring, and in the chapter on grading, sizing and packing. A good deal of valuable data on costs is included, but as is inevitable at the present time such information relates to pre-war values. The need for really efficient spraying equipment is very necessarily stressed.

E. H. G. S.

PLASTICS—SCIENTIFIC AND TECHNOLOGICAL. By H. Ronald Fleck, M.Sc., F.R.I.C. Second Edition. Pp. xlii + 361, 9 × 5½. (London: Temple Press, Ltd., 1946.) Price 30*s*.

The layout of this second edition is similar to that of the first edition (reviewed in this BULLETIN, 1944, **42**, 190) except that the order of the last two chapters (XIV and XV) is now reversed, the Addenda to the first edition have been incorporated in Chapters II, IV and X, and Name and Subject Indexes have been substituted for the single index appearing in the first edition. The author's claim in his preface that " much new material has been included in the text " is rather an overstatement as, apart from an additional six pages on the determination of molecular weights by physical methods, five pages on the use of high frequency heating in the manufacture of plastic articles (" heatronic " moulding), five pages on polymers of ethylene and polyvinylidene chloride and a few additional pages on melamine and methyl methacrylate, the present edition is substantially a reprint of the first with minor alterations in the wording at not very frequent intervals. Chapters VI, VII, XI, XII and XV (XIV in the first edition) are reprints, as are the appendixes, except that there are 100 instead of 68 plasticisers shown in Appendix 4 and, in consequence, the numbering of compatible plasticisers for use with various resins, etc., shown in Appendix 5, has had to be altered. Incidentally, although there are 32 additional plasticisers listed in Appendix 4, only one of these (amyl laurate) figures in Appendix 5.

The book is well illustrated with 90 plates, 12 of which did not appear in the first edition.

In making the alterations mentioned, the author has not always realised amendment to the original wording might be necessary. For example, the paragraph following the account of Schwarz and Wannow's work on regenerated cellulose fibres (wrongly placed under Acetate Rayon on page 258 instead of Viscose) should be reworded as no reference to Chapter X is now required. Again, the opening paragraph of Chapter XV needs recasting as, with the new position of this chapter, the statement is no longer true.

The second edition of " Plastics—Scientific and Technological," whilst providing a very useful survey of all aspects of the plastics industry from the raw materials to the finished products, cannot now be regarded as completely up-to-date, and it is to be hoped that when a third edition is published this will include the latest information available, and that the errors now indicated will be rectified. The opportunity should also be taken to amend page 323 where the ester value is incorrectly described as the saponification value, and consideration should be given to the inclusion of lac and its products, a rather surprising omission from the present work.

H. T. I.

STUDIES IN COLONIAL LEGISLATURES. Edited by Margery Perham. Volume I. THE DEVELOPMENT OF THE LEGISLATIVE COUNCIL, 1606-1945. By Martin Wight. Pp. 187, 9 × 5½. (London: Faber & Faber, Ltd., 1946.) Price 10*s.* 6*d.*

This introductory volume of a series of Studies in Colonial Legislatures, edited by Margery Perham, has appeared at a most appropriate time, when the political future of countries, both large and small, is the subject of much official and unofficial discussion.

It is described on the cover as being equally suitable for the " General reader and for the Colonial Administrator," but it is a book that might well be of interest to all overseas critics of the British Empire.

" The whole (Colonial) system," Mr. Amery once said, " with its haphazard complexity and lack of co-ordination on any structural basis, would, I fancy, not be tolerated for a moment by our more logical neighbours." Mr. Wight has set out to show in a concise and readable form that the political advance of the Colonial Dependencies, however haphazard it may appear, has been slowly developing from the institution of the Colonial Council in seventeenth century Virginia, within a set constitutional pattern.

If the British Commonwealth of Nations is to be no more than " tolerated " in the future by other nations, then deliberations of U.N.O. will have no more force for good in the world than did those of the many inter-war conferences.

A study of the British Colonial System, developing over a period of three and a quarter centuries, can provide many profitable

examples of pitfalls to be avoided and goals to be achieved by any serious striver after a world-wide brotherhood of man, and this book makes a valuable contribution towards such a study.

R. C. H. W.

LAND TENURE IN THE COLONIES. By V. Liversage, B.Sc., M.S., N.D.A. Pp. ix + 151, $7\frac{1}{2} \times 4\frac{3}{4}$. (Cambridge: University Press, 1945.) Price 7*s*. 6*d*.

The author, who is an agricultural economist in Kenya, says in his Foreword: "The purpose of this work is to give a general conspectus of the forms of agricultural land tenure in various parts of the world, to appraise their practical effects and to give some indications of their bearing on colonial policy."

He has described in this book the systems of land tenure under the two main headings, customary and contractual, and has shown how there is in general a progression from what might be described as the most primitive form, the tribal, until that of owner-occupation is reached. In developing the discussion of the various systems he has indicated their respective advantages and weaknesses and has suggested means whereby some of the disadvantages may be overcome. Examples are given of systems of land tenure in operation in various parts of the Colonial Empire and elsewhere. Emphasis is placed on the necessity of suiting the form of tenure to the people and their economic life, it being stated that "a sound system of land tenure must be such as will conduce to the best and most economic use of the land."

The book will be of interest to all those concerned with the administration of the countries of the Colonial Empire on account of the importance of the question of land tenure and its influence on the prosperity of the country and its people.

G. T. B.

FOREST TREE BREEDING AND GENETICS. By R. H. Richens, M.A. Joint Publication No. 8 of the Imperial Agricultural Bureaux. Pp. 79, $9\frac{3}{4} \times 7\frac{1}{4}$. (Imperial Agricultural Bureaux, Central Sales Branch, Penglais, Aberystwyth, 1945.) Price 5*s*.

Professor H. G. Champion in his Foreword to this Joint Publication of the Imperial Bureau of Plant Breeding and Genetics, Cambridge, and the Imperial Forestry Bureau, Oxford, points out that prior to 1925, although a good deal of work had been carried out on the selective breeding of fruit trees, there was no single centre engaged specially on comparable studies of forest trees. Since that year tree breeding has been included as an integral part of a research programme in some countries, e.g. Canada, the United States, Germany, Sweden and South Africa, where a geneticist has been appointed to study wattle trees. There are very good grounds for believing that genetical studies with forest

trees can lead to the isolation and production of better stock. Further, by selective breeding and crossing among different natural strains a new strain may be obtained in which desirable features are increased and undesirable ones decreased.

The author in his Preface describes the object of the publication to be to collate all the literature on forest tree breeding that has appeared since 1930 so as to make it available to all those in the Empire, who are interested in the subject. The introductory section is devoted to a consideration of general principles with a brief account of basic theoretical concepts. The methods so far used are described; these include line breeding, which is slow but gives valuable results; the development of hybrids exhibiting heterosis; and the utilisation of polyploids. Among the criteria used for selection by breeders are timber yield, photoperiodic adaptation, high reproductive capacity, tree shape, quality of the wood, competitive ability and resistance to disease and pests. Each of these characters is considered in general and in the main portion of the monograph with special reference to many important genera.

A glossary of terms and an extensive bibliography are included together with a dual index which gives cross references both to the individual tree genera and to the various aspects of tree breeding principles. The Bulletin contains a great deal of information which should prove of interest and value to all those interested in the breeding of forest trees.

G. T. B.

THE ESTABLISHMENT AND EARLY MANAGEMENT OF SOWN PASTURES. Imperial Bureau of Pastures and Forage Crops, Bulletin 34. Pp. xi + 210, $9\frac{3}{4} \times 7\frac{1}{4}$. (Imperial Agricultural Bureaux, Central Sales Branch, Penglais, Aberystwyth, 1945.) Price 7s.

The establishment and management of pastures in the tropics have been discussed in Bulletin 31 of the Pasture Bureau (see this BULLETIN, 1945, **43**, 225). The present publication which has been prepared in collaboration with the Bureau of Plant Industry, Soils and Agricultural Engineering and the Forest Service of the United States Department of Agriculture deals primarily with the temperate zone, wherein are included all climatic conditions varying from semi-arid to humid. Such a wide range of conditions results in there being recommended a variety of seeds for establishing pastures in crop rotations and swards on newly cleared land reclaimed from forest and other vegetation and on eroded areas.

In order to make this Bulletin as authoritative as possible invitations were extended to a number of experts to contribute. By this means there has been assembled in this publication a series of articles on sown pastures in Great Britain, Canada, Australia, New Zealand, and the United States. These papers deal with that

period of grassland husbandry that extends from the preparation of the soil, through the formulation of a suitable seeds mixture and its sowing, to the management of a sown sward in its early years. They serve to show how the technique of grassland husbandry varies widely according to the nature of the original soil and vegetation and the kind of climate, as well as according to the purpose for which the pasture is grown. The articles lend support to the claim that sown sward should be considered as a crop and therefore deserves as much, if not more, care and attention as are given to any other crop.

The Bulletin is enhanced by the inclusion of a large number (93) of excellent photographic reproductions, which all help to give the reader a better impression of the types of country described in the articles, most of which have excellent bibliographies. An index to genera and species and a key to common plant names are included.

This publication is a valuable addition to the literature on the subject and should prove of great value to all crop agronomists in their desire to obtain up-to-date information on modern methods of and problems connected with the establishment and early management of sown pastures.

G. T. B.

Tea Under International Regulation: Supplementary Comment On. By V. D. Wickizer. Pp. 24, 9 × 6. Food Research Institute, Commodity Policy Studies No. 4. (California: Food Research Institute, Stanford University, 1945.)

Mr. Wickizer's book *Tea under International Regulation*, published in 1944, discussed the operations of the International Tea Exports Regulation Scheme between 1933 and 1943. It was reviewed in this Bulletin, 1944, **42**, 186. On its appearance the book was criticised in some respects by the International Tea Committee who felt that certain explanations were due to interests who might otherwise be led to wrong conclusions about some aspects of their work. This Committee's observations were sent to Mr. Wickizer who in this present memorandum has given some of the Committee's views that were not available to him earlier, has commented on them and has also amended or simplified certain statements made in his book. It must be pointed out in fairness to the author that while he was making his study, he was unsuccessful in establishing communications with the Committee and therefore had to publish his book without the benefit of having had direct contact with them.

G. T. B.

British Commonwealth Objectives. Edited by Sir Harry Lindsay, K.C.I.E., C.B.E. Pp. 288, 7½ × 5. (London: Michael Joseph, Ltd., 1946.) Price 10*s*. 6*d*.

This volume is a collection of twelve papers read by different

authors at meetings of the Royal Society of Arts during the past few years, dealing with various phases of life in the Overseas Empire and illustrates the outstanding objectives of the British Commonwealth of Nations. The editor, who is the Director of the Imperial Institute, in his introduction, shows how the trend of the objectives has changed through the years. In the earliest days of Empire building simple buccaneering was probably the main incentive, which gave place to responsible colonisation, out of which grew naval and commercial supremacy, leading to the professed humanitarian efforts of the nineteenth century and to the present-day objectives of self government, self expression and development of the constituent countries of the Commonwealth. From an Empire of dependent peoples to a union of partners is the creed to which much thought is given to-day.

Viscount Bennett, a former Prime Minister of Canada, in the chapter on Empire Relations, brings home with striking emphasis the diversity of governmental control of the widely different entities united by common allegiance to the Crown. He groups the possessions and controlled territories of the Empire into 18 classes, in each of which the governmental administration is of a different type, varying from a Dominion of federated provinces to an island with a lighthouse but no administration. The complexity of race, creed, culture and environment must of necessity have given rise to great divergence in objectives in the years of development, and it is therefore obvious that in the compass of this small volume the subject after all is but lightly touched on. Nevertheless it represents a most interesting and useful introduction which whets the appetite for reading in greater detail and for more comprehensive study.

The question of capital, expansion and monetary interest in colonies is dealt with in a paper by Lord Hailey, Chairman, Colonial Research Committee, while the relation of Empire primary products to post-war reconstruction is discussed by F. L. McDougall, the Economic Adviser in London to the Australian Government, and Guy Gresford, Australian Scientific Research Liaison Officer, writes on the Scientific Aspects of Australia's Industrial Development. Sir Angus Gillan, Director, Empire Division, British Council, contributes a paper on The Projection of Great Britain on the Colonial Empire. F. H. Andrews, Principal, Amar Singh Technical Institute, Srinagar, describes a centre in London for Oriental culture. Dr. Charles Camsell, Deputy Minister of Mines and Resources for Canada, gives an interesting account of Canada's New North. The Scientific Liaison Officers in London for New Zealand, A. L. Poole and Dr. I. E. Coop, write from their experiences in the scientific collaboration between the United Kingdom and New Zealand in War and Peace. There are chapters by A. P. van der Post, Senior Trade Commissioner for South Africa, on Industrial Development in the Union of South Africa; by Sir Frank Noyce, formerly a Member for Industries and Labour,

Government of India, on Recent Labour Legislation in India; by Sir Bernard Bourdillon, a former Governor of Nigeria, on Partnership in Nigeria; and by Rev. H. M. Grace, who was Principal, Achimota College, Gold Coast, from 1935 to 1940, on Educational Problems of East and West Africa.

J. R. F.

BIBLIOGRAPHY

Compiled by MISS R. M. JOHNSON

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the three months November 1945-January 1946.

The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1. Applications for the Dominion and Indian Governments publications may be made to the Offices of the High Commissioners or Agents-General in London.

AGRICULTURE

General

Agricultural Research in Scotland in 1944. Being a Brief Summary of the Work at the Scottish Agricultural Research Stations and Agricultural and Veterinary Colleges. *Trans. Highld. Agric. Soc. Scot.*, 1945, **57**, 73-87.

Annual Report of the National Research Council of Canada, 1944-1945. Pp. 40, 10 × 6¾. (Ottawa: National Research Council, 1945.)

Report of the Acting Director of Agriculture, Ceylon, for 1943. Pp. 18, 9¾ × 6. (Colombo: Government Press, 1945.) Price 40 cents.

Annual Report of the Director of Agriculture, Cyprus, for 1944. Pp. 8, 13 × 8. (Nicosia: Government Printing Office, 1945.) Price 1*s*.

Second Annual Report of the East African Industrial Research Board, 1944. Pp. 22, 9¾ × 6. (Nairobi: East African Industrial Research Board, 1945.) Price Sh. 1/50.

Report of the Industrial Development Advisory Committee, Development and Social Welfare, Mauritius 1945. Pp. 137, 9¾ × 6½. (Port Louis: Government Printer, 1945.) Price Rs. 2.50.

Annual Report of the Department of Agriculture, New Zealand, for 1944-45. Pp. 24, 13 × 8. (Wellington, N.Z.: Government Printer, 1945.) Price 9*d*.

Annual Report of the Cawthron Institute, Nelson, New Zealand, 1944-45. Pp. 31, 9½ × 6. (Nelson, N.Z.: Cawthron Institute, 1945.)

Report on the Development of Secondary Industries in Northern Rhodesia. By W. J. Busschau. Pp. 91, 9½ × 6½. (Lusaka: Government Printer, 1945.) Price 2*s*. 6*d*.

Report of the Secretary, Department of Agriculture and Lands, Southern Rhodesia, for 1944. *Rhod. Agric. J.*, 1945, **42**, No. 4, 323-344.

Annual Report of the Department of Agriculture, Tanganyika Territory, for 1944. Pp. 9, 9½ × 6. (Dar es Salaam: Government Printer, 1945.) Price 50 cents.

Annual Report of the Department of Agriculture, Uganda, for July 1, 1943, to June 30, 1944. Pp. 10, 9¾ × 6. (Entebbe: Government Printer, 1945.) Price Sh. 1/-.

Report of the Federal Experiment Station in Puerto Rico, U.S. Department of Agriculture, 1944. Pp. 44, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Fifty-seventh Annual Report of the Rhode Island State College Agricultural Experiment Station. Pp. 39, 9 × 6. (Rhode Island: Agricultural Experiment Station, 1945.)

Development and Welfare in the West Indies, 1943-44. Report by Sir Frank Stockdale. Pp. 115, 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 2*s.*

Report on Agriculture, Fisheries, Forestry and Veterinary Matters. By F. L. Engledow. *West India Royal Commission, Cmd.* 6608. Pp. 235, 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 3*s.* 6*d.*

Annual Report of the Department of Agriculture, Zanzibar, for 1944. Pp. 8, 13 × 8. (Zanzibar: Government Printer, 1945.) Price 75 cents.

Rats and Their Destruction. *Bull. No.* 30 (*Revised*), *Minist. Agric., Lond.* Pp. 17, 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 6*d.*

The Soil

Irrigated Pastures for Forage Production and Soil Conservation. By J. G. Hamilton, G. F. Brown, H. E. Tower and W. Collins. *Frms'. Bull. No.* 1973, *U.S. Dep. Agric.* Pp. 30, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 10 cents.

Three Introduced Lovegrasses for Soil Conservation. By F. J. Crider. *Circ. No.* 730, *U.S. Dep. Agric.* Pp. 90, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 20 cents. The grasses concerned are *Eragrostis curvula, E. chloromelas* and *E. lehmanniana.*

Insecticides

(See p. 39.)

Foodstuffs

Beverages

Incompatability in Amazon Cacao. By A. F. Posnette. *Trop. Agric., Trin.*, 1945, **22**, No. 10, 184-187.

Inter-specific Pollination in Theobroma. By A. F. Posnette. *Trop. Agric., Trin.*, 1945, **22**, No. 10, 188-190.

Observations on a Trial of Trees as Shade for Cacao. By C. A. Thorold. *Trop. Agric., Trin.*, 1945, No. 11, **22**, 203-206.

The Mulching of *Coffea arabica.* By S. M. Gilbert. *E. Afr. Agric. J.*, 1945, **11**, No. 2, 75-79.

Cereals

Hybrid Maize for Rhodesia. A Modified Method for Production. By H. C. Arnold. *Rhod. Agric. J.*, 1945, **42**, No. 5, 421-426.

Handling and Storing Soft Corn [Maize] on the Farm. By C. K. Shedd. *Frms'. Bull. No.* 1976, *U.S. Dep. Agric.* Pp. 12, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 5 cents.

Rice in Bombay. By B. S. Kadam. *Indian Frmg.*, 1945, **6**, No. 2, 51-54.

Paddy Cultivation with special reference to the Results of Departmental Trials. By G. V. Wickramasekara. *Trop. Agric., Ceylon*, 1945, **101**, No. 4, 31-38.

Rice Production in Fiji. By M. D. Ffrench-Mullen. *Agric. J. Fiji*, 1945, **16**, No. 3, 63-66.

Large-Scale Wheat Production at Oldeani, Tanganyika Territory, in 1943 and 1944. By C. Redfearn and N. R. Fuggles-Couchman. *E. Afr. Agric. J.*, 1945, **11**, No. 2, 122-129.

The Wheat Midge in the Pacific Northwest. By M. M. Reeher. *Circ.*

No. 732, *U.S. Dep. Agric.* Pp. 8, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Sugar

Report on the Economic Position of the Sugar Industry of British Guiana. By F. C. Benham. Pp. 23, 13 × 8. (Georgetown: Government Printer, 1945.)

Field Experiments with Sugar Cane, XIII. The Variety and Fertilizer Position of the Sugar Industry, X. Report on the Sugar Experiment Stations [British Guiana] for 1944. *Sugar Bull. No.* 13, *Dep. Agric. Brit. Guiana.* Pp. 43, 9 × 7. (Demerara, Georgetown: Department of Agriculture, 1945.)

Proceedings of the Nineteenth Annual Congress of the South African Sugar Technologists' Association held in Durban, April 17-19, 1945. Pp. 91, 11 × 8½. (Mount Edgecombe, Natal: South African Sugar Technologists' Association, 1945.) Price 15*s*. Contains a number of articles on sugar cultivation and production.

Sugar Beet Cultivation in Peshawar. By M. I. Shah. *Indian Frmg.*, 1945, **6**, No. 2, 57-59.

Factors affecting Curly Top Damage to Sugar Beets in Southern Idaho. By D. E. Fox, J. C. Chamberlin and J. R. Douglass. *Tech. Bull. No.* 897, *U.S. Dep. Agric.* Pp. 29, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 10 cents.

Use of Cotton Bags for Storing Sugar. By D. L. Sen and Nazir Ahmad. *Indian Text. J.*, 1945, **56**, No. 662, 135-141.

Root Crops

Potato Growing in New Zealand. By J. H. Claridge. *N.Z. J. Agric.*, 1945, **71**, No. 2, 135-142.

The Cutting and Treatment of Seed Potatoes. By R. M. Nattrass. *E. Afr. Agric. J.*, 1945, **11**, No. 2, 83-85.

The Preservation of Potatoes for Human Consumption. By T. Rendel. *Chem. and Ind., Lond.*, 1945, No. 45, 354-359.

Regional Studies of Time of Planting and Hill Spacing of Sweet Potatoes. By W. S. Anderson, H. L. Cochran *et al. Circ. No.* 725, *U.S. Dep. Agric.* Pp. 20, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 10 cents.

Chilling Injury of Cured and Non-cured Porto Rico Sweet Potatoes. By J. M. Lutz. *Circ. No.* 729, *U.S. Dep. Agric.* Pp. 8, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 5 cents.

Fruits

Annual Report of the East Malling Research Station, near Maidstone, Kent, for 1944, with Supplementary Report on General Development and Activities. Pp. 137, 9¾ × 7¼. (East Malling, Kent: Research Station, 1945.) Price 5*s*.

Report of the Ontario Horticultural Experiment Station for 1943 and 1944. Pp. 61, 9½ × 6. (Ontario: King's Printer, 1945.)

Conserving Soil and Moisture in Orchards and Vineyards. By J. T. Bregger and G. F. Brown. *Frms'. Bull. No.* 1970, *U.S. Dep. Agric.* Pp. 30, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 10 cents.

Lime-Induced Chlorosis of Fruit Trees. A Progress Report on Experimental Work. By H. K. Kemp. *J. Dep. Agric. S. Aust.*, 1945, **48**, No. 12, 526-529.

Respiration of Citrus Fruit after Harvest. By M. H. Haller, D. H. Rose, J. M. Lutz and P. L. Harding. *J. Agric. Res.*, 1945, **71**, No. 8, 327-359.

Date Culture in the United States. By R. W. Nixon. *Circ. No.* 728, *U.S. Dep. Agric.* Pp. 43, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 10 cents.

A Progress Report on the Dying of Limes. By F. M. Bain. *Proc. Agric. Soc. Trin. Tob.*, 1945, **45**, Pt. 2, 123-149.

Pineapple Plant Selection, with special reference to the Elimination of Inferior Types. By H. M. Groszmann. *Queensld. Agric. J.*, 1945, **61**, Pt. 4, 203-215.

Notes on the Dehydration of Apricots, Peaches and Pears. *Aust. Food Manuf.*, 1945, **15**, No. 4, 36-38.

Spices

Vanilla Curing. By F. E. Arana. *Circ. No.* 25, *Puerto Rico Fed. Exp. Sta.* Pp. 21, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 10 cents. Includes the results of vanilla-curing investigations undertaken at this station since 1938.

Vegetables

Winter (Broccoli) and Summer Cauliflower. *Bull. No.* 131, *Minist. Agric., Lond.* Pp. 16, 9¾ × 6. (London: H.M. Stationery Office, 1945.) Price 9*d.*

British Vegetable Dehydration. *Food Manuf.*, 1945, **20**, No. 8, 271-281. This article, prepared by the Technical Staff, Dehydration Division, Ministry of Food, gives in summary form a complete account of the history of the development of the war-time dehydration of vegetables, the processing and drying processes used, and the methods of control in quality.

Breeding Better Vegetables for the South at the U.S. Regional Vegetable Breeding Laboratory. By C. A. Magoon. *Misc. Publ. No.* 578, *U.S. Dep. Agric.*, Pp. 34, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 10 cents.

Fodders and Forage Crops

Algaroba Bean Meal in Turkey Rations. By C. I. Draper. *Circ. No.* 23, *Hawaii Agric. Exp. Sta.* Pp. 5, 9 × 6. (Honolulu: Agricultural Experiment Station, 1945.)

Lucerne. *N.Z. J. Agric.*, 1945, **71**, No. 2, 165-178. General article on the cultivation of the crop with special reference to New Zealand.

The Water Requirement of Alfalfa. By C. S. Scofield. *Circ. No.* 735, *U.S. Dep. Agric.* Pp. 8, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 5 cents.

Alfalfa in Eastern Washington. By E. J. Kreizinger and A. G. Law. *Bull. No.* 462, *Wash. Agric. Exp. Sta.* Pp. 32, 9 × 6. (Pullman, Washington: Agricultural Experiment Station, 1945.)

Alfalfa Varieties in the United States. By H. L. Westover. *Frms'. Bull. No.* 1731 (*Revised*), *U.S. Dep. Agric.* Pp. 17, 9 × 6. (Washington, D.C.: Superintendent of Documents, 1945.) Price 10 cents.

Varieties and Strains of Red and White Clover—British and Foreign. By W. Williams. *Series H, No.* 16, *Welsh Pl. Breed. Sta.* Pp. 26, 9¾ × 7¼. (Aberystwyth: Welsh Plant and Breeding Station, 1945.) Price 2*s.* 6*d.*

The Composition of Different Types of Star Grass (*Cynodon plectostachyum*). By M. H. French. *E. Afr. Agric. J.*, 1945, **11**, No. 2, 100-103.

Oils and Oil Seeds

Solvent Extraction of Cottonseed and Peanut Oils. By E. F. Pollard, H. L. E. Vix and E. A. Gastrock. *Industr. Engng. Chem., Industr. Ed.*, 1945, **37**, No. 10, 1022-1026.

Étude de la Destruction des Carotenoides au cours du Soufflage de l'Huile

de Palme. By P. Dubouloz and S. Lalement. *Bull. Inst. Colon. Marseille, Mat. Grasses*, 1945, **29**, Nos. 3 and 4, 35-38.

Étude Économique sur le Palmier à Huile. By M. Massenet. *Série Tech. No.* 1, 1945, *I.R.H.O.* Pp. 103, 10½ × 8¼. (Paris: Institut de Recherches pour les Huiles de Palme et Oléagineux, 1945.)

Développement de l'Acidité dans les Huiles de Palme. By M. M. Lowry and Y. Becker. *Bull. Inst. Colon. Marseille, Mat. Grasses*, 1945, **29**, Nos. 1 and 2, 5-13.

Développement de l'Acidité dans les Huiles de Palme. By M. M. Lowry and J. Max. *Bull. Inst. Colon. Marseille, Mat. Grasses*, 1945, **29**, Nos. 3 and 4, 25-34.

Cultivation and Systematic Study of the Tung Oil Yielding Trees in India. By K. Biswas. *J. Sci. Industr. Res. India*, 1945, **4**, No. 5, 260-272.

Fibres

Descriptive Notes on Some Mexican Brush Fibres. By H. H. Unsworth. Pp. 68, 10½ × 8½. (Monterrey, N.L., Mexico, 1943.) Contains information on the extraction, preparation, grading, etc., of lechuguilla, ixtle de jaumave, guapilla, palma, palma pita and zamandoque.

The Packaging of American Cotton and Methods for Improvement. By J. W. Wright, F. L. Gerdes and C. A. Bennett. *Circ. No.* 736, *U.S. Dep. Agric.* Pp. 62, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 15 cents.

The Utilisation of Jute Waste. By C. R. Nodder. *J. Sci. Industr. Res. India*, 1945, **4**, No. 3, 128-129.

A Small Separator for the Recovery of Milkweed Floss and Seed. Part I. Construction and Operation. By D. H. Hamly. *Canad. J. Res.*, 1945, **23**, No. 5, Sec. F, 313-325.

Paper-making Materials

La Production Éventuelle de Pâtes à Papier au Congo Belge. By E. Frison. *Bull. Agric. Congo Belge*, 1944, **35**, Nos. 1-4, 183-204. Discusses the possibilities of a number of raw materials of the Congo as paper-making materials.

Rubber

Common Latex Bearing Woody Plants of India. By K. L. Budhiraja and R. Beri. *Indian For. Leafl.*, No. 70, 1944. Pp. 18, 8½ × 5½. (Dehra Dun: The Forest Research Institute, 1944.) Price As. 6.

La Préparation du Caoutchouc en Extrême-Orient. By M. Schoofs. *Bull. Agric. Congo Belge*, 1944, **35**, Nos. 1-4, 6-11.

Report of Conference on Post-War Preparation and Packing of Rubber, held under the auspices of the London Advisory Committee for Rubber Research (Ceylon and Malaya). Pp. 31, 8½ × 5½. (London: Imperial Institute, 1945.)

Cryptostegia Leaf Rubber. By S. R. Hoover, T. J. Dietz, J. Naghski and H. W. White. *Industr. Engng. Chem., Industr. Ed.*, 1945, **37**, No. 9, 803-809.

Tobacco

Biology of the Tobacco Hornworm in the Southern Cigar-Tobacco District. By A. H. Madden and F. S. Chamberlin. *Tech. Bull. No.* 896, *U.S. Dep. Agric.* Pp. 51, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Drugs

The Drug Resources of North West Frontier Province. By N. A. Qazilbash. *Pharm. J.*, 1945, **155**, No. 4283, 249-250.

Le Quinquina. By E. H. J. Stoffels. *Série Tech. No.* 24*a*, 1945, *I.N.E.A.C.* Pp. 57, 9½ × 6¼. (Costermansville, Congo Belge: Institut National pour l'Étude Agronomique du Congo Belge, 1945.) Price Fr. 50. This second edition brings up to date the information on the production of quinine in the Belgian Congo.

Streptomycin—Origin, Nature and Properties. By S. A. Waksman and A. Schatz. *J. Amer. Pharm. Assoc., Sci. Ed.*, 1945, **34**, No. 11, 273-290.

Streptomycin. A Review. By S. A. Waksman and A. Schatz. *J. Amer. Pharm. Assoc., Pharm. Ed.*, 1945, **6**, No. 11, 308-321. Summarises the work on this new antibiotic drug to date.

Plantas Medicinales Aromáticas o Venenosas de Cuba. By J. T. Roig. *Publ. Minist. Agric. Cuba.* Pp. 1313, 9 × 6. (Havana, Cuba: Ministry of Agriculture, 1945.) In two parts. Part I contains a glossary of terms used, a list of the groups of plants according to their uses, botanical classification, and descriptive accounts in alphabetical order; Part II completes the descriptive accounts, contains the index, a list of alternative names used in other parts of America and a bibliography.

Miscellaneous Agricultural Products

Food Yeast. A Survey of the Nutritive Value. By the Accessory Food Factors Committee, Medical Research Council. *War Mem. No.* 16, *Med. Res. Coun.* Pp. 15, 9¾ × 6. (London: H.M. Stationery Office, 1945.) Price 3*d*.

Manufacture of Yeast in India. Some Scientific Problems. By P. N. Vohra and Bashir Ahmad. *J. Sci. Industr. Res. India*, 1945, **4**, No. 5, 272-275.

Peanut Protein Hydrates. Utilisation as Tacky and Remoistening Adhesives. By R. S. Burnett, E. D. Parker and E. J. Roberts. *Industr. Engng. Chem., Industr. Ed.*, 1945, **37**, No. 10, 980-982.

Pectin from Indian Plant Materials. By M. Damodaran and P. N. Rangachari. *J. Sci Industr. Res. India.*, 1945, **4**, No. 5, 298-300.

Livestock and Animal Products

Report on the Department of Animal Health, Gold Coast, 1944-45. Pp. 6, 13 × 8. (Accra: Government Printing Department, 1945.) Price 1s.

Annual Report on the Veterinary Department, Nigeria, for 1943. Pp. 25, 9¾ × 6½. (Lagos: Government Printer, 1945.) Price 1*s*.

Dairy Farming in the Northern Sudan. By J. W. Hewison. *E. Afr. Agric. J.*, 1945, **11**, No. 2, 104-109.

The Carotene and Vitamin A Content of Creamery Butter produced in Washington. By U. S. Ashworth, M. McGregor and H. A. Bendixen. *Bull. No.* 466, *Wash. Agric. Exp. Sta.* Pp. 8, 9 × 6. (Pullman, Washington: Agricultural Experiment Station, 1945.)

Manufacture of Glandular Products. *J. Sci. Industr. Res. India*, 1945, **4**, No. 5, 281-283.

Fourth Annual Report of the Leather Industries Research Institute, Rhodes University College, Grahamstown, South Africa, for 1944-45. Pp. 59, 9¾ × 7¼. (Grahamstown, South Africa: Leather Industries Research Institute, 1945.)

The Fisheries of Jamaica. Report by E. F. Thompson. *Bull. No.* 18, *Development and Welfare in the West Indies.* Pp. 103, 9×6. (Barbados: Advocate Co., Ltd., 1945.) Price 30 cents.

Diseases of Bees. *Bull. No.* 100, *Minist. Agric., Lond.* Pp. 25, 9½×6. (London: H.M. Stationery Office, 1945.) Price 9*d*.

FORESTRY

General

Report of the Forest Department, British Honduras, for 1944. Pp. 13, 7¼ × 9. (Belize: Government Printer, 1945.)

Annual Report on the Forestry Department, Gold Coast, for 1944-45. Pp. 7, 13 × 8. (Accra: Government Printing Department, 1945.) Price 1*s*.

Annual Report of the Forest Department, Mauritius, for 1944. Pp. 12, 9½ × 6. (Port Louis: Government Printer, 1945.) Price 50 cents.

Annual Report of the Director of Forestry, New Zealand, for the year ended March 31, 1945. Pp. 35, 13 × 8. (Wellington, N.Z.: Government Printer, 1945.) Price 1*s*.

Annual Report of the Forestry Department, Nyasaland, for 1944. Pp. 12, 13 × 8. (Zomba: Government Printer, 1945.)

Report of the Conservator of Forests, Trinidad and Tobago, for 1944. Pp. 6, 13 × 8. (Trinidad: Government Printer, 1945.) Price 6 cents.

The Management of Cypress Plantations in Kenya. By S. H. Wimbush. *Pamphl.* No. 11, *For. Dep. Kenya.* Pp. 31, 9½ × 6. (Nairobi: Government Printer, 1945.)

Pine Plantations in Mauritius. Working Plan Report. By H. C. King. Pp. 81, 9½ × 6. (Port Louis: Government Printer, 1945.)

A Note on the Insect Borers of Bamboos and their Control. By J. C. M. Gardner. *Indian For. Bull. No.* 125 (*Entomol.*), *For. Res. Inst.* Pp. 17, 9 × 5½. (Dehra Dun, U.P.: The Forest Research Institute, 1945.) Price As. 12.

Timber

Indian Woods for Battery Separators. By M. A. Rehman and S. M. Ishaq. *Indian For. Bull., No.* 124—1944 *Utiliz.* (*New Series*). Pp. 20, 8½ × 5½. (Dehra Dun, U.P.: Forest Research Institute, 1945.) Price As. 12.

Beetles Attacking Seasoned Timber in South Africa. By F. G. C. Tooke. *Bull. No.* 246, *Dep. Agric. Un. S. Afr.* Pp. 15, 9½ × 6. (Pretoria: Government Printer, 1944.) Price 3*d*.

Pentachlorophenol Solutions for the Preservation of Wood. By P. M. D. Krogh. *Frmg. S. Afr.*, 1945, **20**, No. 237, 761-769.

Gums and Resins

Ethers and Ether-Esters of Lac and their Polymerisation. Part III. By B. S. Gidvani and N. R. Kamath. *Tech. Pap. No.* 28, *Shellac Res. Bur.* Pp. 19, 8½ × 5½. (London: Shellac Research Bureau, 1945.)

Tanning Materials

The Vegetable Tanning Materials of India. Part I. Survey. By R. L. Badhwar, A. C. Dey and M. V. Edwards. *Indian For. Leafl.*, No. 72, 1944. Pp. 39, 8½ × 5½. (Dehra Dun, U.P.: The Forest Research Institute, 1944.) Price As. 8.

Effect of Method of Drying on the Composition of Dwarf Sumac Leaves and on the Leather Produced. By I. D. Clarke and H. Hopp. *J. Amer. Leath. Chem. Assoc.*, 1945, **40**, No. 10, 363-378.

IMPERIAL INSTITUTE

CONSULTATIVE COMMITTEE ON INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

QUARTERLY BIBLIOGRAPHY OF INSECTICIDE MATERIALS OF VEGETABLE ORIGIN, NO. 33

(October to December 1945)

Compiled by MISS R. M. JOHNSON

With the collaboration of the Imperial Institute of Entomology and the Department of Insecticides and Fungicides, Rothamsted Experimental Station.

GENERAL

Insecticidal Tests for Control of Green Clover Worm and *Autographa* on Snap Beans. By L. W. Brannon. *J. Econ. Ent.*, 1945, **38**, No. 3, 403-404. Pyrethrum and derris tested.

Control of Potato Leafhoppers infesting String Beans. By E. H. Fisher and T. C. Allen. *J. Econ. Ent.*, 1945, **38**, No. 3, 392-393. Sabadilla and pyrethrum among the products tested: sabadilla satisfactory.

The Caraway Moth and Its Control. By H. W. Frickhinger. *Chem. Zentr.*, 1944, No. 2, 153-154. (*Amer. Chem. Absts.*, 1945, **39**, No. 18, 4186.) Early dusting or spraying with derris or pyrethrum successful in controlling the moth *Depressaria nervosa*.

Recent Experimental Work on the Control of the Apple Sawfly (*Hoplocampa testudinea*). *Proc. Ent. Soc. Brit. Columbia*, 1944, **41**, 29-30. (*R.A.E.*, 1945, **33**, A, Pt. 11, 334.) Nicotine sulphate spray used: quassia extract and soap spray as effective as nicotine.

Rep. Fed. Exp. Sta. Puerto Rico, 1944. The section on insecticidal crop investigations contains information on the following: derris planting material distributed to Latin America; high-yielding clones of derris multiplied; excellent derris plants developed from leafy cuttings; excess moisture detrimental to derris cuttings; *Lonchocarpus utilis* propagated by several methods; use of paraffin increased survival of cuttings; relative toxicity of rotenone plants; losses of rotenone during storage; yam bean investigations: plant toxicity studies—*Mammea americana* and *Pachyrhizus erosus* found toxic.

Winter Control of Cattle Lice. By J. A. Munro and H. S. Telford. *Bull. No.* 324, *N. Dakota Agric. Exp. Sta.*, 1943. (*Brimstone Brevities*, 1945, No. 10, May, 168-169.) Dusts containing rotenone or pyrethrum are effective in control of cattle lice but war-time restrictions limited their use.

New Developments in Insecticides. By L. D. Goodhue. *Iowa Coll. J. Sci.*, 1945, **19**, No. 3, 255-262. (*Exp. Sta. Rec.*, 1945, **93**, No. 4, 461.) Concerns DDT, synergists for insecticides, better pyrethrum extracts, fumigants and insecticidal aerosols.

Parasiticidal Compositions. U.S. Pat. No. 2,378,309. *Amer. Chem. Absts.*, 1945, **39**, No. 17, 3874. Certain organic compounds which have parasiticidal properties and act as carriers for toxicants; also have a synergistic effect when mixed with pyrethrins and rotenone.

The Coverage Factor in the Application of Dusts. By N. Turner. *J. Econ. Ent.*, 1945, **38**, No. 3, 359-364.

Proprietary Insecticides and Fungicides. *Chem. Tr. J.*, 1945, **117**, No. 3044, 328. Further products added to the list of proprietary products officially approved by the Ministry of Agriculture for the control of plant pests and diseases.

Insecticide Testing. By F. C. Nelson. *Soap*, 1945, **21**, No. 6, 124-126.

ALKALOID-CONTAINING MATERIALS

Tobacco Products, including Nicotine and Nicotine Derivatives

Effect of Nicotine applied with Calcium Arsenate at Different Times of Day upon Cotton Aphids and Yields. By M. T. Young, G. L. Smith, G. L. Garrison and R. C. Gaines. *J. Econ. Ent.*, 1945, **38**, No. 3, 383-384.

Role of the Wetter in Apple Sawfly Control. By G. A. Cater. *J. Minist. Agric.*, 1945, **51**, No. 12, 563-566. Addition of a wetter to nicotine wash improved the control of *Hoplocampa testudinea* Klug.

On the Biogenesis of Nicotine and Nornicotine. By R. F. Dawson. *J. Amer. Chem. Soc.*, 1945, **67**, 503. (*Pharm. Absts.*, 1945, **11**, No. 9, 226, in *J. Amer. Pharm. Assoc., Sci. Ed.*, 1945, **34**, No. 9.)

Nicotine Cyanide for Roaches. By E. L. Mayer, J. B. Gahan and C. R. Smith. *U.S. Dep. Agric., Bur. Entomol.*, E-646, 1945. *Soap*, 1945, **21**, No. 9, 131.

Relative Efficiencies of Nicotine Sulphate and certain Arsenates for Control of Diamond-back Moth. By W. Cottier and H. Jacks. *N.Z. J. Sci. Tech.*, 1945, **27**, No. 1, 37-39.

Chrysanthemum Midge (*Diarthronomyia chrysanthemi* Ahl.). *Adv. Leafl. No.* 286, *Minist. Agric., Lond.*, 1945. Nicotine spray recommended for control.

Can we control Cat-facing and Curculio in Illinois ? By S. C. Chandler. *Trans. Ill. Hort. Soc.*, 1943, **77**, 493-505. (*R.A.E.*, 1945, **33**, Pt. 10, A, 316.) A dust mixture of nicotine and sulphur gave little or no reduction in the percentage of injured fruit.

Nicotine Content of *Nicotiana rustica* grown in Kentucky and of Fifteen Selections of Dark Tobacco. By C. W. Woodmansee, K. E. Rapp and J. S. McHargue. *Bull. No.* 470, *Kentucky Agric. Exp. Sta.*, 1944.

The Home-Production of Nicotine. By R. F. Batt and H. Martin. *Ann. Rep. Agric. Hort. Res. Sta. Long Ashton*, 1944, 140-144.

Anabasine

Anabasine Sulphate: a Protective Agent against Bites of Malarial Mosquitoes. By V. A. Nabokov. *Med. Parasitol. U.S.S.R.*, 1944, **13**, No. 3, 42-50. (*Amer. Chem. Absts.*, 1945, **39**, No. 19, 4398.)

A Review of Information on Anabasine and Nornicotine, 1938-44. By R. C. Roark. *U.S. Dep. Agric., Bur. Entomol.*, E-636, 1945.

Others

The Alkaloids of *Sedum acre* L. By L. Marion. *Canad. J. Res.*, 1945, **23**, Sec. B., 165-166. Nicotine has been isolated from the plant.

INSECTICIDE MATERIALS CONTAINING ROTENONE AND ALLIED SUBSTANCES

General

Rotenone Analysis. The Rotenone Content of Samples of Derris, Lonchocarpus and Tephrosia from Central and South America, the Belgian Congo and Tahiti. By R. H. Carter, S. B. Soloway, H. D. Mann and N. Green. *Soap*, 1945, **21**, No. 4, 127.

Grub Control on Dairy Cattle in the North-east. By J. G. Matthysse. *J. Econ. Ent.*, 1945, **38**, No. 4, 442-446. Rotenone is the only known effective insecticide.

Goat Lice. By O. G. Babcock and E. Cushing. *Sheep Goat Rais.*, 1943, October. (*Brimstone Brevities*, 1945, No. 10, 166.) Wettable sulphur and derris (or cube) dips efficient.

Trials with DDT on Potatoes, Cabbages and Squash. By W. N. Bruce and O. E. Tauber. *J. Econ. Ent.*, 1945, **38**, No. 4, 439-441. Indication

that 1 per cent. DDT was slightly more efficient in control of the cabbage worm than 1 per cent. rotenone dust; for squash vine borer control 3 per cent. DDT more effective than 1 per cent. rotenone, giving nearly complete control.

Addition of Extractives of Rotenone-bearing Plants to Spray Oils. By W. Ebeling, F. A. Gunther, J. P. la Due and J. J. Ortega. *Hilgardia*, 1944, **15**, No. 7, 675-701. (*R.A.E.*, 1945, **33**, A, Pt. 11, 349.)

Rotenone for Cattle Grubs. *U.S. Dep. Agric., Bur. Entomol.*, E-623, 1945. (*Soap*, 1945, **21**, No. 9, 131.)

Wash for Cattle. *Bull. Assoc. Amer. Soap and Glycerine Prod.*, 1945, Sept. (*Soap*, 1945, **21**, No. 4, 156.) Made with cube or derris and granular laundry soap.

Tetralopha scortealis (Led.), a New Insect Pest of Lespedeza. By F. W. Poos and L. A. Hetrick. *J. Econ. Ent.*, 1945, **38**, No. 3, 312-315. Rotenone dust failed to give satisfactory control.

A Review of the Insecticidal Uses of Rotenone and Rotenoids from Derris, Lonchocarpus (Cube and Timbo), Tephrosia and related Plants. Part VII, Lepidoptera. Part VIII, Hymenoptera. By R. C. Roark. *U.S. Dep. Agric., Bur. Entomol.*, E-625 and E-630, 1944.

Stable Rotenone Dispersion. U.S. Pat. No. 2,358,073. *Soap*, 1945, **21**, No. 9, 129.

Rotenone Imports into United States. *Chem. and Drugg.*, 1945, **144**, No. 3438, 724. Permission restored to import rotenone by private arrangement on March 31, 1946.

Derris

The Location and State of Rotenone in the Root of *Derris elliptica*. By F. A. Gunther and F. M. Turrell. *J. Agric. Res.*, 1945, **71**, 61-79.

Beet Webworm. By H. Jarvis. *Queensld. Agric. J.*, 1945, **60**, Pt. 6, 355-357. Derris dust suggested for control.

Derris Diluents. By F. E. Whitehead. *Proc. Oklahoma Acad. Sci.*, 1945, **24**, 27-28. (*Soap*, 1945, **21**, No. 9, 131.) The toxicity of derris to the housefly is influenced greatly by the kind of carrier or diluent used.

Cube

Cattle Grubs Killed in Kansas—and How. By E. G. Kelley. *Agric. Ldrs. Dig.*, 1944, May. (*Brimstone Brevities*, 1945, No. 10, 167.) Cube-pyrophyllite dust and sprays or washes of wettable sulphur and cube effective.

Large Scale Power Dusting of Feeder Lambs for Winter Control of the Sheep Tick. By J. G. Matthysse. *J. Econ. Ent.*, 1945, **38**, No. 3, 285-290. The most effective dust used was a mixture of cube, pyrophyllite and motor oil.

PYRETHRIN-CONTAINING MATERIALS

A Treatment for Head Lice, Crab Lice and Scabies. By G. Eddy. *War Med.*, 1944, **6**, Nov., 319-322. (*Soap*, 1945, **21**, No. 6, 147.) The formula (SYLN) includes pyrethrins.

Comparison of Four Insecticides, including DDT, in Mineral Oil for Control of the Corn Earworm [*Heliothis armigera*] in Dent Seed Corn. By R. A. Blanchard and A. F. Satterthwait. *U.S. Dep. Agric., Bur. Entomol.*, E-664, 1945. (*Amer. Chem. Absts.*, 1945, **39**, No. 17, 3872.) Pyrethrum one of the materials used in the tests; DDT the only insecticide which protected the corn till harvesting.

The Residual Toxicity of the Pyrethrins to *Anopheles quadrimaculatus*: Preliminary Studies. By R. L. Metcalf and C. E. Wilson. *J. Econ. Ent.*, 1945, **38**, No. 4, 499.

The Control of Rural Malaria by Pyrethrum Dusting. By P. C. C. Garnham and J. O. Harper. *E. Afr. Med. J.*, 1944, **21**, No. 10, 310-320. (*R.A.E.*, 1945, **33**, B, Pt. 9, 137-138.)

Malaria Investigations in North Kanara. By Jaswant Singh and V. P. Jacob. *J. Malar. Inst. India*, 1944, **5**, No. 3, 267-303. (*R.A.E.*, 1945, **33**, B, Pt. 11, 168-169.) Pyrethrum spray useful against adult mosquitoes.

Tests of DDT and Pyrethrum in Oil Solutions and in Emulsions against the Earworm [*Heliothis armigera*] in Sweet Corn. By R. A. Blanchard and A. F. Satterthwait. *U.S. Dep. Agric., Bur. Entomol.*, E-665, 1945. (*Amer. Chem. Absts.*, 1945, **39**, No. 19, 4427.) DDT in mineral oil or in an emulsion gave better control than did pyrethrum.

The Control of Tobacco Thrips on Seedling Peanuts. By F. W. Poos. *J. Econ. Ent.*, 1945, **38**, No. 4, 446-448. Pyrethrum not so effective as DDT.

Pyrethrum as a Tsetse Fly Repellent: Human Experiments. By J. R. Holden and G. M. Findlay. *Trans. Roy. Soc. Trop. Med. and Hygiene*, 1944, **38**, No. 3, 199-204. (*Exp. Sta. Rec.*, 1945, **93**, No. 4, 471.)

Laboratory Tests of Insecticides for Tobacco Moth and Cigarette Beetle. By J. N. Tenhet. *J. Econ. Ent.*, 1945, **38**, No. 4, 449-451. Pyrethrum included in the materials tested.

Insecticide Toxicity Studies. Experimental Results on the Comparative Toxicity of Benzene Hexachloride, DDT and Pyrethrum. By W. A. Gersdorff and E. R. McGovran. *Soap*, 1945, **21**, No. 11, 117, 121.

Some Compounds containing the 3-4-methylene dioxyphenyl group and their Toxicities towards Houseflies. By M. E. Synerholm and A. Hartzell. *Contrib. Boyce Thompson Inst.*, 1945, **14**, No. 2, 79. A number appear to be synergists for pyrethrins.

The Toxicity of DDT to the Housefly, *Musca domestica* L. By E. A. Parkin and A. A. Green. *Bull. Ent. Res.*, 1945, **36**, Pt. 2, 149-162. DDT at 1 per cent. gives an effective spray for practical use but at lower concentrations the speed of knock-down is too slow; this disadvantage can be overcome by the admixture of a small amount of pyrethrum and the toxicity of the mixture may be increased by the incorporation of a suitable activator.

Insecticide (3-4-methylene dioxycinnamides). U.S. Pat. No. 2,326,350. *Brit. Absts.*, 1945, Nov., BIII, 223. Consists of pyrethrum, mineral oil and one of the above series of compounds.

Pyrethrum in the Belgian Congo. *Chem. Tr. J.*, 1945, **117**, No. 3056, 690. Increase in production during war years.

Pyrethrum Production. Belgian Congo and Ruanda-Urundi. *Foreign Comm. Wkly.*, 1945, **21**, No. 6, 30.

Pyrethrum Production in Brazil. *Foreign Comm. Wkly.*, 1945, **20**, No. 8, 30; **21**, No. 1, 22.

Pyrethrum in Kashmir. By I. C. Chopra, M. L. Dhar, *et al.* *Current Sci.*, 1945, **14**, 104-105. (*Amer. Chem. Absts.*, 1945, **39**, No. 18, 4193.)

U.S. Interest in Kenyan Pyrethrum Processing Plants. *Chem. Tr. J.*, 1945, **117**, No. 3055, 654. American firms reported to be interested in the possibility of building plants in East Africa for processing pyrethrum.

An Upland Farm in Kenya. By C. H. Stockley. *Country Life*, 1945, **98**, No. 2549, 906. Mentions pyrethrum and expresses the opinion that it is unlikely to pay as a post-war crop in view of the discovery of new synthetic compounds.

Pyrethrum Expansion Costly, says Kenya Head. *Soap*, 1945, **21**, No. 9, 133, 147.

Pyrethrum Purification. U.S. Pat. No. 2,358,292. *Soap*, 1945, **21**, No. 6, 135. Impure pyrethrum extracts are distilled with sesame oil.

Pyrethrum Stabiliser. U.S. Pat. No. 2,375,773. *Soap*, 1945, **21**, No. 11, 131D.

Antioxidants for Pyrethrum Powders. By R. C. Bushland, M. S. Schecter, H. A. Jones and E. F. Knipling. *Soap*, 1945, **21**, No. 11, 119, 121.

Official Test Insecticide. *Soap*, 1945, **21**, No. 6, 137, 141. A solution of pyrethrum extract in refined kerosene.

OTHER INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

Insecticidal Properties of Miscellaneous Plants. By R. Hansberry and

R. T. Clausen. *J. Econ. Ent.*, 1945, **38**, No. 3, 305-307. The plants examined were from four sources (1) Brazilian fish poison plants, (2) legumes and other plants of New York State, (3) insecticidal, fish-poison or medicinal plants of Mexico and Central America, (4) miscellaneous.

The Castor-bean Plant as a Source of Insecticides: A Review of the Literature. By N. E. McIndoo. *U.S. Dep. Agric., Bur. Entomol.*, E-666, 1945. (*Amer. Chem. Absts.*, 1945, **39**, No. 19, 4413.) Title only.

Insecticidal Properties of Euphorbia Extracts. *Nature*, 1945, **156**, No. 3974, 782. Letter by F. L. Vanderplank with reference to some tests on *E. dendroides* in Tanganyika.

The Relative Effectiveness of the Principal Alkaloids of Sabadilla Seed. By T. C. Allen *et al.* *J. Econ. Ent.*, 1945, **38**, No. 3, 293-296.

Increased Toxicity of Lime-Treated Sabadilla Seed in Dust Suspensions. By T. C. Allen and L. K. Brunn. *J. Econ. Ent.*, 1945, **38**, No. 3, 291-293.

Effectiveness of Sabadilla in Control of Cabbage Worms. By L. K. Brunn and T. C. Allen. *J. Econ. Ent.*, 1945, **38**, No. 3, 392.

Toxicity of Sabadilla to Chinch Bugs and Squash Bugs. By H. D. Tate and D. B. Gates. *J. Econ. Ent.*, 1945, **38**, No. 3, 391.

Reduction of Certain Insects Infesting Alfalfa by Use of Sabadilla. By T. C. Allen, F. J. Dexheimer and E. Cole. *J. Econ. Ent.*, 1945, **38**, No. 3, 389-390.

Sabadilla Dust to Control the Squash Bug. By R. J. Dicke, F. J. Dexheimer and T. C. Allen. *J. Econ. Ent.*, 1945, **38**, No. 3, 389.

Insecticide. U.S. Pat. No. 2,348,949. *Pharm. Absts.*, 1945, **11**, No. 9, 233, in *J. Amer. Pharm. Assoc., Sci. Ed.*, 1945, **34**, No. 9. Sabadilla the active constituent.

Field Tests of the Thunder God Vine against Melon Leaf Beetle. By Tien-Hsi Cheng. *J. Econ. Ent.*, 1945, **38**, No. 4, 491-492. The ground bark of the roots of *Tripterygium forrestii* Loes effective and a promising insecticide especially in China.

Insecticide Research. A Review of the Constitution and the Toxic Effect of Botanical and New Synthetic Insecticides. By P. Laüger, H. Martin and P. Müller. *Helv. Chim. Acta*, 1944, **27**, No. 4, 892-938. (*Soap*, 1945, **21**, No. 9, 121-123, 147.)

MINERAL RESOURCES

ARTICLE

PROGRESS IN GEOLOGICAL INVESTIGATIONS AND MINERAL DEVELOPMENTS IN THE GOLD COAST[1]

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The Gold Coast, although it covers an area of only 92,000 sq. miles and has a relatively small population (approximately 4,000,000), is one of the richest Crown Colonies. It is the world's largest producer of cocoa, the second or third largest producer of diamonds (in quantity), and the third largest producer of high-grade manganese ore ; and is also the largest producer of gold in the Colonial Empire. The value of the mineral production in 1939 (the latest year for which official statistics have been published) was exceeded only by those of Malaya and Northern Rhodesia.

The writer proposes to describe briefly the history of geological and mineral development and to give a summarised account of the geology and mineral resources (stressing unusual and outstanding features), and finally to indicate the possible future trends of geological investigation, prospecting and mineral development.

History

Prior to 1900 very little was known regarding the geology of the Gold Coast. In 1827, Thomas Park, son of Mungo Park, journeyed inland for some 50 miles from Accra and wrote a brief account of the geology of the district ; in 1836 Sir Roderick Murchison referred to fossils collected from Accra by Sir Charles Bullen ; in 1843 Dr. Stanger described the rocks at Cape Coast and compared the sandstones at Accra with those near Liverpool ; and in 1868 Dr. J. A. Horton noted the striking resemblance of the geology of the Gold Coast to that of Brazil, and predicted that diamonds would be found in the eastern districts of the Gold Coast and coal in the interior.

The year 1878 witnessed the commencement of European mining and in 1882 four companies were developing the banket deposits at Tarkwa. Previously gold had been won by the natives for more than 400 years.

Two important geological articles appeared in 1890 ; the first, by E. Halse, described the geology and mineralogy of the Tarkwa

[1] Lecture delivered on November 29th, 1945 at the Imperial Institute.

banket deposits and recognised their similarity with the banket deposits of Johannesburg; the second, by G. E. Ferguson, an African who had studied geology at the Royal School of Mines, described some features of the geology of the eastern part of the Colony and Ashanti.

The gold boom early in the present century led to intensive development of the principal goldfields and to a marked increase in our knowledge of the geology and structure of the Tarkwa goldfield. Several geological reports were written about this time, probably the most important being those by A. R. Sawyer in 1901 and 1902, by S. J. Truscott in 1902, and by B. I. Collings in 1909. Sawyer published a geological map of the Tarkwa goldfield and both he and Truscott recognised the synclinal structure of the banket. The report by Collings on the Tarkwa goldfield is still consulted by geologists and mining engineers.

The year 1913 marked an important stage in the progress of geological research in the Gold Coast, for it was in this year that the first official Geological Survey was formed. In the early stages the work of the Department, which combined a mineral and geological survey, was chiefly confined to examining the country as rapidly as possible by a network of traverses.

In 1914 the Geological Survey discovered the large manganese-ore deposits near Nsuta and also the Ejuanema bauxite deposit. In 1919 and 1920 they discovered diamonds at many places in the Birim Valley around Abomoso, Kade, Oda and Manso, and in 1921 and 1922 they discovered large deposits of bauxite near Yenahin and Sefwi-Bekwai and diamonds in the Bonsa river near Tarkwa. The commercial development of the manganese and diamond deposits ceommnced in 1916 and 1920 respectively, and of bauxite in 1940.

Until 1925 the work of the Survey was principally devoted to geological reconnaissances, prospecting for minerals, and water investigations. In that year the geological mapping of the Tarkwa goldfield was commenced and *Bulletin No.* 1 of the Survey was published.

The increase in the price of gold in 1931 gave a great impetus to gold mining and gold prospecting, and for some years the activities of the Geological Survey were chiefly concerned with assisting the development of this industry. A comprehensive survey of the gold resources of the country was carried out, detailed examinations were made of the geology of the principal gold belts and gold mines and of most of the gold prospects, scores of diamond-drill bore cores were logged, and thousands of rocks and minerals were identified for companies and prospectors. At the same time the reconnoitring and prospecting of little known areas was continued, detailed studies were made of the principal diamond and manganese deposits and of special geological problems, such as the Bosumtwi Caldera and the Accra earthquake, and numerous water-supply investigations were carried out on behalf of the Government.

During the course of these investigations between 1930 and 1939, many new occurrences of gold, diamond, manganese ore, bauxite, limestone and other minerals were found, and several areas favourable for closer prospecting were located.

A Water Supply Section of the Geological Survey was formed in 1937, and started constructional work in the Northern Territories in March 1938.

At the outbreak of the war six of the nine European officers of the Department were called up to form Water-Supply Units of the Gold Coast Regiment. These officers served with distinction in the East African Campaign in Somaliland and Abyssinia, and later in Kenya and the Gambia, and returned to the Department in 1943-44. While they were in the Forces, they located and tested sites for bore-holes and wells by geological and geophysical means and constructed more than 400 water-supply works of various types.

In September 1939, only two officers (Director and Senior Geologist) were left to carry on in the Geological Section and one in the Water Supply Section. The latter, assisted for a time by the Senior Geologist, continued constructional work in the Northern Territories until March 1942, when he retired and the Section was closed down. During the period 1938-1942 the Section constructed 23 dams, 19 ponds and 272 wells for a cost of approximately £25,000. The results achieved were of greater value to the people generally than all the works previously constructed in the Northern Territories. Furthermore, the masons and well-sinkers trained by the Section trained others in their turn, and they together constructed a large number of wells for the Native Administrations.

The Director and Senior Geologist continued the geological mapping and prospecting of mining fields and little-known areas, and carried out special investigations for strategic minerals and minerals for local use, and of water supplies for the Forces and for the Government.

The Bibiani and Konongo goldfields and the principal manganese and bauxite deposits were geologically mapped, and the Department was instrumental in getting the Ejuanema and Sefwi bauxite deposits opened up. Certain districts were prospected for mica, and occurrences of quartz crystals, limestone, molybdenite, and sands for glass-making and Portland cement testing were examined.

During the past two years the work of the Survey has been largely devoted to water-supply and building-materials investigations. Detailed hydro-geological surveys were made of the coastal region east and north-east of Accra, and of the Voltaian basin, which covers nearly half of the Gold Coast and includes practically all the dry areas of the Northern Territories. The construction of water-supply works was resumed in the Northern Territories, and examinations were made of water supplies in connection with post-war planning, and also of the resources of brick, tile and pottery clays in the vicinity of the principal towns in the Colony and Ashanti.

A Temporary Water Supply Department was formed in April 1944. The Geological Survey organised the formation of this Department and supervised its work until the arrival of the Director at the end of September.

The first geological map of the Gold Coast, a provisional one, was published in 1928. This map was considerably revised and republished in 1938. During the war geological maps of the Tarkwa goldfield and the Nsuta manganese deposits, of the Birim and Bonsa diamondfields, and of the Konongo goldfield were published, and a geological map of the Bibiani goldfield, and geological and hydrological maps of the Voltaian basin and the Accra Plains and Volta Delta, were completed. Many areas other than those covered by the published 1 in. and ½ in. geological maps have been mapped on similar scales, some in such detail that the maps could be published now or after a little additional work.

The publications of the Survey consist of six Memoirs, fourteen Bulletins, Annual Reports from 1913-14 to 1939-40, and several Sessional Papers and other Government publications. Three Memoirs and four Bulletins were published during the war and two Memoirs are ready for publication.

The total expenditure on the Geological Survey from 1913 to March 31, 1943, was approximately £225,000, equivalent to an average annual expenditure of £7,600. The total direct revenue received by the Government in the form of export duties on manganese ore and diamonds alone is nearly three times the total cost of the Geological Survey since 1913, and in recent years it has averaged about five times the annual cost of the Survey.

Physical Features

The Gold Coast may be broadly divided into the following physical divisions:

(1) The low-lying coastal plains and deltas extending inland from the coast irregularly for distances up to 15 or 20 miles.

(2) The intermediate zone consisting of highly dissected plain residuals and ranges of hills separated by wide flat-bottomed valleys. The country has a steady fall to the south; the general level is well below 1,000 ft., but the higher hills and ranges rise to 1,500-2,500 ft. above sea-level.

(3) The highlands of Voltaian sandstones stretching for 120 miles in a north-westerly direction from Koforidua to Wenchi and forming the principal watershed of the country. The south-western limit of the highlands is marked by prominent erosional scarps rising in places to 1,500 ft. above the adjoining country. The highest points on the highlands are from 2,500 to 2,800 ft. above sea-level.

(4) The Volta basin, which is geographically and geologically a basin; it comprises a fairly flat interior, 300-600 ft. above sea-level, surrounded by highlands with outward facing

scarps, except on the eastern side, where the scarps face inwards. The highlands include those mentioned in (3).

(5) The Akwapim and Togo ranges, and the Kpandu, Nkonya and Dutukpene highlands to the west. The Togo range attains a maximum altitude of about 3,000 ft. in the Gold Coast and 3,366 ft. at Agu Mountain in French Togoland, and the Nkonya hills rise to 2,700 ft.

(6) The plateau of the Wa, Lawra, Navrongo and Bawku districts in the northern section of the Northern Territories. This plateau has an average altitude of 800-1,000 ft.

The post-Cretaceous history of the country is one of intermittent uplifts and gentle warping. Remnants of two widespread erosion surfaces are known, both of which are important from the mineral standpoint, and there is evidence of other erosion surfaces, the extent and age of which are imperfectly known.

The younger of the two principal erosion surfaces is probably of late Tertiary age, as it forms the uppermost terrace of the present rivers and bevels sediments which are separated from the underlying Eocene beds in the Volta delta by another strong erosion surface. Dissected remains of the surface rise gently inland from an altitude of 150-200 ft. on the coast to about 1,000 ft. at the foot of the scarped highlands mentioned under (3) above. Further north the surface is nearly flat except for slight down-warping within and near the Volta basin. The Wa-Navrongo plateau (No. 6 above) is part of the surface.

Highly dissected remnants of the older surface, which is a peneplain of probably early to middle Tertiary age, occur at many places in the Colony, Ashanti and Togoland at 1,700-2,500 ft. above sea-level and about 1,000-1,500 ft. above the late-Tertiary surface. Relics of it also occur in the Northern Territories at 1,400-1,700 ft.

The peneplain is fairly flat for 40-80 miles south of the Voltaian escarpment and then gradually decreases in height to 1,000 ft. at 30-40 miles from the coast and to about 600 ft. near the coast. To the north of the Voltaian escarpment the peneplain appears to be slightly down-warped.

The surface of the peneplain is strongly lateritised where the composition of the underlying rocks is favourable for lateritisation, and all the important bauxite deposits in the Gold Coast occur on it.

In some localities, notably Togoland, there are residuals up to 800-1,000 ft. above the peneplain. It is possible that these are relics of an earlier erosion surface.

From the evidence of widespread raised beaches, river and lake terraces, and of the drowned mouths of some of the rivers, it is apparent that appreciable relative movements of land and sea took place in the Pleistocene period. The principal raised beaches are at 10-20, 30-50, 70-80 and 100-120 ft. above sea-level and there are extensive river terraces at 25-40, 60-80, 100-120 and 200-300 ft. above the river beds. The bed of the Den Su, near Accra, and also

that of the Ankobra, near Axim, is more than 60 ft. below sea-level.

Geology

The oldest sediments containing fossils the age of which has been determined, are those of Middle Devonian age at Accra. These rocks and the still younger sediments of Carboniferous, Cretaceous, and Tertiary age are confined to within 20 miles of the coast. The Voltaian sediments, which are part of the Horizontal Sandstone Series of Devonian to Ordovician (?) age in the Ivory Coast and French Guinea, contain sponge spicules, fragments of plants, and concentric growths resembling *Collenia*, none of which are of diagnostic value.

The pre-Voltaian formations belong to two classes, those which are older than the main period of granitic intrusion (Archaean, including the Birrimian), and those younger than the granites (Tarkwaian, Akwapimian and Buem, all of which are probably pre-Cambrian in age).

The pre-Voltaian rocks are generally closely folded along N.-N.E. lines and are penetrated by various types of igneous rocks and veinstones, whereas the Voltaian and younger sediments are normally flat bedded or gently inclined, and are almost free from intrusions. The Devonian and younger rocks generally dip seawards.

Archaean

The typical Archaean rocks are restricted to the south-eastern corner of the Gold Coast. They consist partly of basic igneous gneisses that have suffered a high degree of metamorphism, have high specific gravities and are often rich in garnet, and partly of acidic gneisses, schists and migmatites, together with some quartzite and dolomitic marble. Most of the acidic gneisses were originally sediments. They show marked evidence of migmatitisation, but the basic gneisses were not greatly affected. Intrusions of granite, pyroxenite, nepheline-syenite, porphyry, aplite, pegmatite and dolerite occur in the Archaean.

The principal economic minerals are dolomite, which has been worked near Accra, and almandine garnet which has a potential value as an abrasive. Small occurrences of kyanite, soapstone, impure chromite, rhodonite-gondite, and a little alluvial gold are also known.

Birrimian

The Birrimian has been sub-divided into a lower, very thick, series of argillaceous and impure sandy and tuffaceous sediments—now slates, phyllites, greywackes, tuffs and schists—and an upper series of greenstones, consisting chiefly of metamorphosed basic lavas and intrusives, with some acidic lavas and pyroclastics, and minor amounts of phyllite and greywacke. Bands of gondite and manganiferous phyllite, which are often associated with hornstone and chert, occur in the upper part of the greenstones.

Alternating beds of phyllite and greywacke are characteristic of the lower Birrimian. Pure quartzites and limestones are lacking and even impure limestones containing original carbonate are uncommon. Pebbly beds are also rare. Finely divided carbonaceous matter is present in most of the phyllites, which contain up to 6 per cent. carbon. The great thickness of these argillaceous sediments is an unusual feature in the basement rocks of West Africa.

Intruded into the Birrimian, but older than the Tarkwaian, are large bathyliths of older granite and smaller masses of soda-rich granite, granodiorite and porphyry (younger granite).

The Birrimian is the most important mineral-bearing formation in the Gold Coast; in it occur practically all of the lode-gold and manganese deposits, as well as many other minerals of lesser importance.

Tarkwaian

The Tarkwaian rocks in the type area (Tarkwa goldfield) consist of a thick series of argillaceous and arenaceous sediments (mainly arenaceous), with two well-defined zones of pebbly beds in the lower members of the system. The total thickness of the rocks, including intrusives, is approximately 8,000 ft. The sediments form part of a long and narrow geosyncline stretching in a north-easterly direction from near Axim to beyond Konongo, where it is covered by the Voltaian. The source of the sediments was to the east (north-east to south).

At the base of the system is a conglomeratic member termed the "Kawere Group"; this is succeeded in turn by (*a*) quartzites, grits and conglomerates of the Banket Series, (*b*) an argillaceous formation (Tarkwa phyllite), and (*c*) the Huni Sandstone. The banket lies about 2,500 ft. above the base of the system.

Sills and dykes of igneous rock, ranging from felsite and quartz-porphyry to meta-dolerite, gabbro and norite, are common in the Tarkwaian.

The Tarkwaian rocks were folded along similar north-east lines to the Birrimian. Near Tarkwa the folding is open, but elsewhere closely packed folds are the rule. The metamorphism is generally much less severe than in the Birrimian, but in one area the sediments have been converted into schists containing abundant staurolite, garnet, biotite and kyanite.

Gold is the principal economic mineral in the Tarkwaian, but diamonds occur in some of the conglomerates.

Akwapimian and Buem

The Akwapimian rocks, which are mainly quarzite, quartzschist, phyllite and sericite-schist, form the Akwapim-Togo-Atacora fold range stretching for 500 miles in a north-easterly direction from the coast to the Niger.

Intense pressure metamorphism directed from the south-east

resulted in overfolding and overthrusting and the prevailing south-easterly dip of the beds. Isoclinal folding is the rule, but recumbent folds are common at the contact of the sediments with the underlying granites and gneisses. The contact is often a low-angle thrust plane.

The Buem formation occurs to the west of the Akwapimian and is separated from it by a zone of shearing and faulting. It consists of an upper group of basaltic, andesitic and trachytic lavas, a middle group of shale, limestone, tillite, conglomerate and quartzite, and a lower group of shales, mudstones and impure sandstones.

The Buem rocks are highly folded and generally dip to the east owing to overfolding. The intensity of the folding is a little less than in the Akwapimian.

Koert (1910) suggested a Permo-Carboniferous age for the Buems, presumably because of the tillite, whereas Kitson and Robertson considered them to be equivalent to the Birrimian. These interpretations are now known to be incorrect, and it is believed that the Buems are of late pre-Cambrian or early Cambrian age.

Small masses of gabbro, peridotite, pyroxenite and serpentine, containing in places a little chromite and asbestos, penetrate the Akwapimian and Buem rocks, and a little gold occurs in the Buem conglomerates and volcanics.

Voltaian

The Voltaian System, the most extensive sedimentary formation in the Gold Coast, has recently been studied in detail and sub-divided on stratigraphical and lithological grounds as follows:

	Name and description of beds	*Maximum thickness*
UPPER VOLTAIAN	*Upper Sandstones*—Quartz sandstones with thin beds of shale and mudstone	700 ft.
	Thin-bedded Sandstones—Flaggy micaceous, ferruginous and felspathic sandstone	400 ft.
LOWER VOLTAIAN	*Obosum Beds*—Red and green arkoses, mudstones and shales, with Sang conglomerate and tillite and some limestone and quartz-sandstone	500 ft.
	Oti Beds—Akroso conglomerate, arkose, sandstone, mudstone, shale and limestone	800 ft.
	Basal Sandstones—Quartz-sandstone and pebbly grit	200 ft.

The Sang conglomerate is of especial interest as it contains boulder beds with striated pebbles, which the writer is convinced are tillites and fluvio-glacial deposits.

The Voltaian sediments were deposited in a basin on a surface of relatively low relief, which around the margin of the basin normally varies in altitude from 400 to 1,500 ft., and in the centre of the basin is probably slightly above sea-level.

The sediments are flat or slightly inclined except on their eastern margin, where the Oti and Obosum beds are folded, probably

due to the final movements connected with the folding of the adjacent Buem and Akwapimian rocks.

No igneous rocks are known in the Voltaian, although dolerite sills cut the corresponding rocks in French territory.

The Voltaian contains few minerals of economic importance, the most important being the bauxite deposit at Mt. Ejuanema and numerous widely scattered deposits of limestone and clay. Salt is produced on a small scale at Daboiya, near Tamale, where there is also some barite. Alluvial gold and diamonds have been found in some of the main rivers draining Voltaian rocks. Large quantities of water are stored in the Upper Sandstones.

Accraian (Devonian) and Sekondian (Carboniferous ?)

These sediments occur as narrow strips along the coast near Accra and between Cape Coast and Dixcove. They are mainly of marine origin, but the basal beds of the Sekondian, west of Sekondi, contain an interesting boulder bed underlain by crumpled varved shales, which is possibly of glacial origin.

The principal economic minerals and rocks in the Accraian and Sekondian are clay, sand and gravel.

Cretaceous

A series of alternating sandy and clayey sediments with pebbly beds and some limestone, more than 4,000 ft. thick, extends inland for some 10 miles from the coast near the Ivory Coast frontier. Fossils collected from outcrops of the shales and limestones have been determined by Dr. L. R. Cox to be of Upper Cretaceous (Campanian-Maestrichtian) age.

Oil-bearing sands and oil-seepages are known at several places, and oil and gas have been obtained in a number of boreholes but not in commercial quantities. At least twelve boreholes were drilled at intervals during the past 40 years, but with two exceptions —those drilled in 1924—they were sunk without any knowledge of the structure of the underlying beds and no logs were kept. The area is mostly covered by swamps and lagoons, and exposures of the sediments are few and far between. The structure and stratigraphy cannot therefore be determined accurately except by modern methods of prospecting, including geophysical surveys and drilling. It is hoped that such an investigation will be eventually carried out. There is also a possibility, perhaps a remote one, that coal may occur in the sediments, as the Nigerian coal measures are of Upper Cretaceous age.

Fossiliferous shales and limestones of Upper Cretaceous age and foraminiferal limestones of Eocene age have recently been discovered in wells in the Volta delta between Keta, Djoje and Denu. They rest on a surface of weathered granite, which is inclined seawards, and are overlain unconformably by a series of unfossiliferous argillaceous sands. Dr. Cox has determined the age of the Cretaceous

sediments as Maestrichtian, and Lt.-Colonel Davies considers the age of the foraminiferal limestone to be probably Middle Eocene.

Tertiary to Recent

The only sediments definitely known to be of Tertiary age are the foraminiferal limestones referred to above, but it is very probable that the overlying argillaceous sands, and the Amisian sediments at Saltpond and other places along the coast, as well as the deposits of laterite and bauxite capping the high hills, are of this age.

The crater, 39½ sq. miles in area, in which Lake Bosumtwi (18 sq. miles) is situated, was formed probably in early Pleistocene times by a series of explosions followed by subsidence. The rim of the caldera is unbroken and rises 450 to 1,450 ft. above the lake, which is 311 ft. above sea-level and 240 ft. deep in the centre.

Lacustrine deposits of clay, sand and gravel occur up to 160 ft. above the present level of the lake; some of the clays contain abundant fish and plant remains.

The caldera is the only one of its kind known in this part of West Africa. No satisfactory explanation has yet been advanced for its being where it is.

MINERALS

The principal minerals of economic importance are gold, diamond, manganese ore and bauxite, all of which are being produced on a fairly extensive scale, together with small quantities of salt and limestone and minor amounts of other minerals. The accompanying tables (p. 54) illustrate the growth and importance of the mineral industry and the paramount part played by gold mining. Details of the production of bauxite, salt and limestone are not included in the statistics as figures for these minerals are not available.

At the beginning of the present century the average annual value of the mineral production was only £38,000. From this figure it gradually increased to £1,744,500 in 1914 and then declined to £710,000 in 1928-29, the lowest figure for the past 40 years. Since then the value of minerals has forged ahead, chiefly due to the increase in the value of gold, and in 1941-42 reached a total of £9,160,000, excluding the value of bauxite. The compulsory closing of some of the gold mines in 1942 caused a sharp recession which, with the hoped for reopening of these mines in the near future and increased supplies of materials and labour, should only be temporary.

The total value of the mineral production from 1880 to March 31, 1945, was approximately £120,000,000, of which gold accounted for £90,000,000.

All the known deposits of minerals of major economic importance occur in the Colony and Ashanti within an area having a radius of 60 miles from Dunkwa, a town 100 miles from Takoradi on the railway to Kumasi. This area produces well over 90 per cent. of the minerals exported and contains the richest known concentration

GOLD COAST

Production of Gold, Manganese and Diamonds

	Gold *Fine oz.*	Manganese Ore *Tons.*	Diamonds *Carats exported.*
To 31-3-1934 .	8,170,564 (*a*)	3,666,763 (*b*)	
1934-35 . .	337,065	336,337	9,805,701 (*c*)
1935-36 . .	367,819	439,096	
1936-37 . .	461,621	438,681	1,478,822
1937-38 . .	590,025	569,203	1,380,336
1938-39 . .	701,416	272,282	1,440,322
1939-40 . .	818,911	457,357	869,836
1940-41 . .	882,241	(*e*)	940,000 (*d*)
1941-42 . .	879,973	(*e*)	980,000 (*d*)
1942-43 . .	721,315	(*e*)	1,239,000 (*d*)
1943-44 . .	536,727	(*e*)	984,000 (*d*)
1944-45 . .	527,628	(*e*)	862,021
	14,995,305		19,980,038

(*a*) 1880 *to March* 1934. *For details of annual production see Gold Coast Geol. Surv. Mem. No.* 4, 1935. (*b*) 1916 *to March* 1934. (*c*) 1920 *to March* 1936. (*d*) *Approximate* (*includes diamonds won by Africans*). (*e*) *Production figures* 1940 *to* 1945 *not yet available.*

Value of Mineral Production (1935 to March 1945)
(*Excluding Bauxite, Salt, Limestone and Silver*)

	Gold £	Manganese Ore £	Diamonds £	Total £
1935	2,635,527	612,170	546,094	3,793,791
1936	3,047,545	612,930	584,997	4,245,472
1937	3,910,757	1,025,091	648,057	5,583,905
1938	4,841,633	907,972	548,027	6,297,632
1939	6,165,873	789,607	464,439	7,419,919
Jan.-March 1940 .	1,700,000 (*a*)	210,000 (*a*)	125,000 (*a*)	2,035,000 (*a*)
1940-41 . . .	7,410,824	927,294 (*a*)	540,000 (*b*)	8,878,118 (*b*)
1941-42 . . .	7,392,000	1,192,000 (*a*)	567,000 (*b*)	9,151,000 (*b*)
1942-43 . . .	6,059,056	1,210,000 (*a*)	607,000 (*b*)	7,876,056 (*b*)
1943-44 . . .	4,508,507	1,132,000 (*a*)	505,000 (*b*)	6,145,507 (*b*)
1944-45 . . .	4,432,075	(*c*)	431,000 (*b*)	——

(*a*) *Estimated.* (*b*) *Approximate.* (*c*) *Not available.*

Gold Mining Statistics

	1906.	1914.	1938-39.	1940-41.	1942-43.
Tons crushed .	293,143	770,467	1,890,875	2,590,608	2,174,302
Fine oz. gold .	214,566	410,655	701,417	882,241	721,315
Development footage	—	—	184,203	191,511	63,994
Dredging—					
Yards treated .	—	—	5,110,572	7,478,911	2,568,900
Fine oz. gold .	15,154	—	20,252	37,603	15,942
African labour .	13,580	15,204	30,534	35,274	32,420
European labour .	576	537	872	763	585

Royalties, Export Duty and Profits Tax

	£		£
1930-31 .	100,000	1937-38 .	336,153
1931-32 .	87,012	1938-39 .	486,647
1932-33 .	91,203	1939-40 .	699,513
1933-34 .	165,428	1940-41 .	1,022,334
1934-35 .	304,500	1941-42 .	1,032,367
1935-36 .	288,844	1942-43 .	965,123
1936-37 .	304,532		

of economic minerals in West Africa. The factors responsible for this concentration of useful minerals are partly geological and structural and partly erosional. The principal geological factor is the wide and deep geosyncline of little-metamorphosed Birrimian and Tarkwaian rocks in the central and western parts of the Colony and Ashanti ; the favourable structural factors are the deep-seated faults and shear zones formed during the folding of the Birrimian rocks and during their intrusion by granitic rocks; and the favourable erosional factors are the intense pre-Tarkwaian erosion of the Birrimian and Tertiary to Recent erosion of the Birrimian and other rocks. The pre-Tarkwaian erosion was probably responsible for the concentration of gold in the Tarkwaian banket, of diamonds in the basal conglomerates of the same system, and, in places, of manganese oxides from the lean Birrimian manganese formation ; and the Tertiary to Recent erosion for the enrichment of manganese ores and bauxite, and for the formation of payable concentrations of alluvial diamonds and gold, and of oxidised ores of the Marlu and Justice's type.

Some of the Gold Coast ore deposits are exceptionally large and rich and others are of unusual types. Examples of the former are (*a*) the ore bodies of the Ashanti Goldfields mine, the richest large gold mine in the world, which has produced 4,939,000 oz. of gold from 4,844,000 tons of ore during the past 33 years; (*b*) the phenomenal concentrations of alluvial diamonds near Akwatia and Atiankama (Birim Diamondfield), which have already yielded more than 17 million carats (more than 3,000,000 carats came from an area of less than a quarter of a square mile at Esuboni) ; and (*c*) the enormous bodies of high-grade manganese ore at Nsuta mine, which is the largest individual producer of high-grade manganese ore in the world and also one of the largest, if not the largest, producer of chemical (battery) ore.

The ore bodies at Marlu mine and between there and Brumasi, and those at Justice's mine, are the best examples of the unusual types of ore deposit. These ore bodies consist of great widths of mineralised sheared phyllites and tuffs, which have been oxidised to depths of more than 100 ft.

The Marlu oxidised ores were worked by opencast methods using electrically driven shovels, and until the mine was closed down by the Government in 1942 produced 554,960 oz. of gold from 3,736,478 tons of ore. The ore reserves at that date were 5,472,469 tons averaging 3¼ dwt. gold per ton.

At Justice's approximately 100,000 oz. of gold were won from the oxidised ores in the opencut and 135,000 tons of sulphide ore assaying 11·7 dwt. have since been proved in the underground workings.

The south ore body at Bibiani mine is of a somewhat similar type. Long before development was completed on this ore body it was estimated to contain 1,000,000 tons of ore averaging 5·7 dwt. per ton over a width of 55 ft.

Gold

The recorded production of gold from 1880 to March 31, 1945, is 15 million oz., and it is estimated that a similar amount was won by the Africans prior to 1880. Of the total production since 1904, 69 per cent. came from lode mines in Birrimian rocks, 29 per cent. from the Tarkwaian banket and 2 per cent. from alluvial sources.

A summarised statement of production and yields from lode and banket mines during the periods January 1905 to March 1934 and April 1934 to March 1945 is given below. A comparison of the figures shows how the grade of the ores, especially that of the banket, has been reduced during the past decade :

	Lode Deposits			Banket Deposits		
Period.	*Tons.*	*Fine oz.*	*Yield dwt./ton.*	*Tons.*	*Fine oz.*	*Yield dwt./ton.*
Jan. 1905-Mar. 1934	7,368,000	4,686,417	12·7	6,006,300	2,768,429	9·2
Apr. 1934-Mar. 1945	11,944,000	5,224,549	8·7	5,897,800	1,398,567	4·7
Totals	19,312,000	9,910,966	10·3	11,904,100	4,166,996	7·0

Ores in Birrimian Rocks.—Lode deposits are widely distributed in Birrimian rocks, the most favourable localities being, in general :

(*a*) The flanks of synclinal depressions in the Birrimian, especially near the boundaries between the Upper Birrimian and Lower Birrimian, and between the Upper Birrimian and Tarkwaian, on the western side of the geosyncline of Tarkwaian rocks from Axim to beyond Konongo.

(*b*) Both the Upper and Lower Birrimian close to intrusions of younger granite and porphyry.

All the ore bodies of any size occur in deep-seated shear zones, faults, or fractures, which are generally located along the contacts between rocks of markedly different competency.

The principal ore bodies are quartz reefs, but lenses of sheared rock (generally phyllite or tuff) impregnated with auriferous pyrite and arsenopyrite, and stockworks, are not uncommon, the latter often being associated with porphyry intrusions. The ores at the Ashanti and Ariston mines are examples of the first type and those at Marlu, Justice's and Nanwa of the second type, while all three types are present at Bibiani.

The following characteristics of the gold-quartz reefs in the main ore channels should be kept in mind by anyone interested in searching for or developing them :

(*a*) The reefs are lenses, which are generally richest in gold where they are longest and widest, and poorest where they are shortest and narrowest.

(*b*) The lenses are often several hundred feet apart longitudinally and up to 300 ft. or more in depth.

(*c*) There is rarely any payable ore in the channels between the lenses.

(*d*) In most of the payable reefs the gold occurs in fractures in sheared and shattered quartz which readily disintegrates on weathering and rarely forms outcrops. On the other hand barren quartz often makes prominent outcrops.

Ores in Tarkwaian Rocks.—With the exception of a few hundred ounces of gold won from quartz reefs, and 82,656 oz. won from the banket at Ashanti-Adowsena mine, south-east of Kumasi, the whole of the production was obtained from the banket of the Tarkwa goldfield.

Placer Deposits.—Placer deposits have been extensively worked by both Europeans and Africans. The recorded production of alluvial gold by European companies from 1903 onwards is approximately 250,000 oz., 95 per cent. of which came from dredging the flats and beds of the Ofin, Ankobra, Tano, Fura, Pra and Birim rivers. The average recovery of gold from past and recent dredging is approximately 2½ grains per cubic yard. At present three dredges are operating on the Ankobra river and a fourth one is being built. Other dredges may be erected on the Ofin and Jimi rivers, the flats of which are reported to contain very large deposits of auriferous gravel.

Manganese Ores

Small deposits of manganese ore occur at several places in association with a low-grade manganese-bearing formation, containing from 7 to 30 per cent. manganese and 35 to 55 per cent. silica, in the Upper Birrimian rocks, but none of them is of economic importance at the present time, apart from the large deposits at Nsuta, 39 miles from the port of Takoradi, and small deposits near Dixcove.

The Nsuta ores occur on two parallel ridges extending for 2½ miles in a N.-N.N.E. direction and rising to 400 ft. above the streams at the foot of the hills. The country rocks of the ores are phyllites and deeply weathered metamorphosed lavas and tuffs, which are intruded by a few small masses of porphyry. A typical section through one of the principal hills shows a capping of detrital ore resting upon large lenticular high-grade ore bodies. The upper parts of these ore bodies consist chiefly of hard lateritic ore containing only a little quartz, which was formed by the action of descending surface waters in Tertiary to Recent times on the underlying soft black ore. Veins of white quartz, showing little or no staining or veining by manganese oxides, cut the black ore. The ore bodies are believed to have been deposited as shallow-water sediments and later to have been folded and enriched by vadose and possibly hydrothermal solutions.

Most of the ore, which consists essentially of pyrolusite and psilomelane, is used for the manufacture of manganese steel and

a moderate amount is used for battery purposes.[1] The mine workings are of the opencast type, the ore being excavated mainly by power shovels. Some of the ore is sintered at the mine. A modern loading plant, having a capacity of 1,000 tons an hour, is in operation at Takoradi.

The total exports of manganese ore to March 31, 1940, were 6,432,542 tons, valued at £11,000,000. Subsequent figures have not yet been released.

Diamonds

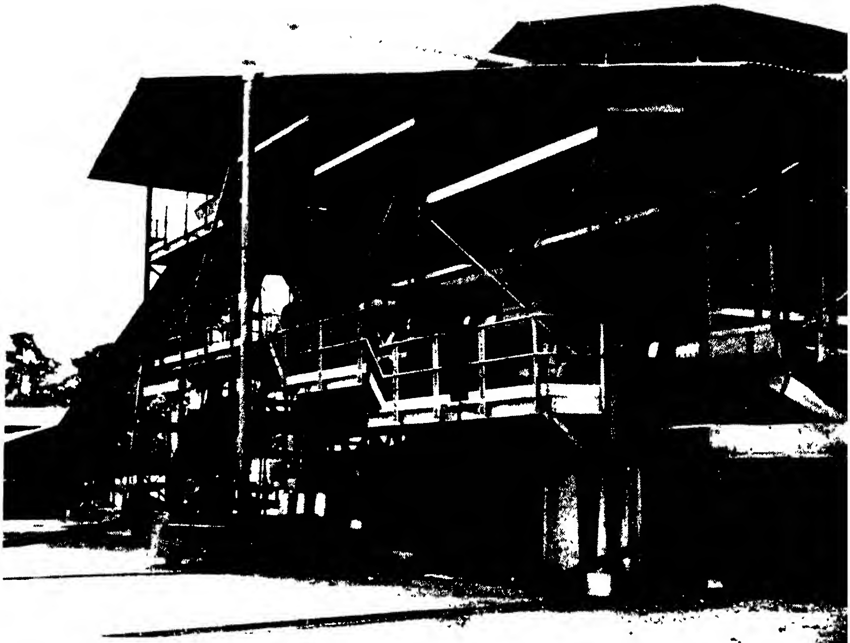
Alluvial diamonds are worked by European companies in the Birim valley, near Kade, Oda and Akwatia, some 70 miles north-west of Accra, and by Africans near the Bonsa river, south-west of Tarkwa.

Birim Diamondfield.—This field is responsible for nearly 95 per cent. of the total Gold Coast production of diamonds. The producing mines are all situated within six miles of the Birim, and most of them are less than four miles from it. The deposits being worked are mainly confined to the shallow gravels, averaging 2-3 ft. in thickness, in the beds and flats of the smaller streams. Overlying the gravels is a sheet of sandy clay and silt averaging about 2 ft. in thickness. The present and former gravels of the large streams, and the terraces of the small streams, also carry large quantities of diamonds. Up to the present they have been worked only on a small scale, but, with the gradual exhaustion of the more easily accessible shallow deposits, it is probable that they will receive much more attention.

The rocks of the diamondfield are steeply dipping, isoclinally folded, metamorphosed igneous, pyroclastic and sedimentary rocks of Birrimian age. Between Akwatia and Atiankama there are outcrops of a metamorphosed, brecciated, ultrabasic igneous rock, now composed chiefly of tremolite, with some talc, chlorite, carbonaceous matter and accessory rutile. The Birrimian rocks are intruded to the south by a large bathylith of granite. The contact lies some two miles to the south of the most southerly diamond workings.

Characteristic features of the diamonds are their small size (the + 1 mm. stones average 0·05 carat), the relatively large percentages of boart and of brown and green diamonds, the rarity of yellow diamonds, and the scarcity of water-worn diamonds. Boart comprises 35-45 per cent. of the total production, and fine sand 10-20 per cent. The total production of diamonds from the Birim diamondfield up to March 31, 1945, exceeded 19,000,000 carats, and the largest recorded stone weighed only about 4½ carats. Two diamonds of larger size, one 10½ carats and the other 7½ carats, have been found in the Northern Territories.

[1] The United States Geological Survey report that an X-ray investigation of Nsuta battery ore shows that it consists principally of γ-MnO_2 together with some pyrolusite and cryptomelane.



Diamond recovery plant, Akwatia, showing conveyor (left) and three rotary gravel wasl

PLATE II

Diamonds on grease table Jig concentrates are carried by water over these shaking grea coated tables to which the diamonds adhere.

Road from Mount Ejuanema to Nkawkaw The construction of this jungle road was completed by 5,000 Africans in 110 days.

Bauxite mine, Mount Ejuanema The loose ore is dug by shovel excavators, then hand sorted by labourers.

The most common minerals in the concentrates are staurolite, ilmenite, limonite, rutile and tourmaline, together with small amounts of zircon, magnetite, haematite, kyanite and andalusite. Chrysoberyl and gorceixite occur among the rare minerals.

The diamonds are believed to be of local origin and to have been derived from the Birrimian rocks. Similar diamonds have been found in the Tarkwaian banket, indicating a pre-Tarkwaian age for the diamonds.

Bonsa Diamondfield.—The first diamond from this district was discovered by the Geological Survey in 1922. Subsequent prospecting proved the existence of numerous small deposits of alluvial diamonds in a belt about 14 miles long and one to four miles wide, stretching from near Tarkwa to Simpa. The gravels of several small streams on the north and south sides of the Bonsa, near Simpa and Dompim, have been worked by the Africans since 1933.

The gravels average one to two feet in thickness and the overburden two to three feet. The underlying rock in most of the workings is the Kawere conglomerate, and the diamonds appear to have been derived from this rock. The concentrates, which consist mainly of staurolite, tourmaline, kyanite and ilmenite, with some gold and zircon, and scanty corundum, spinel, chrysoberyl and gorceixite, are typical of the Birrimian, and the Kawere conglomerate in this district is composed largely of pebbles of Upper Birrimian rocks. The diamonds are of average Gold Coast quality and size. The total recorded production to March 1945 was roughly 430,000 carats. Declared production is now averaging about 4,000 carats per month.

Bauxite

The largest and most promising bauxite deposits are situated near Chichiwere and Mpesaso in the vicinity of Yenahin, 40 miles west of Kumasi; near Sefwi Bekwai, 55 miles north-west of Dunkwa; at Mount Ejuanema, two miles from Nkawkaw railway station; and in the hills east of the Bia river, 40 miles north-west of Wiawso.

The Yenahin deposits occur on the flat tops of the high hills north of Yenahin at altitudes of 2,200-2,400 ft., and are scattered over a length of some 20 miles. The bauxite varies from 20-50 ft. in thickness and rests on Birrimian phyllites, grits, lavas and pyroclastics.

The Sefwi Bekwai deposits form cappings, up to 70 ft. thick, on a group of hills 1,500-1,700 ft. above sea-level. The ores are derived from argillaceous slates and schists of Birrimian age.

The Ejuanema deposits, which are derived from flat-bedded Voltaian shales, form a capping, averaging about 20 ft. thick, on the crest of Mt. Ejuanema, about 2,500 ft. above sea-level.

The Ejuanema deposits and the Kanaiyerebo deposit in the Sefwi Bekwai group were opened up during the war and several

hundred thousand tons of ore have been shipped to date. To facilitate the transport and handling of the bauxite a railway was constructed from the main line at Dunkwa to Awaso, at the foot of Kanaiyerebo hill, and a road was constructed from there to the top of the hill. A road was also constructed from the Ejuanema deposit to Nkawkaw railway station, and a loading plant was erected at Takoradi.

Other Minerals

Reference has already been made to the occurrences of oil in Apollonia, and to chromite, soapstone and asbestos in the Eastern Province of the Colony.

Salt is obtained by evaporation of sea-water in the Ada and Keta districts and from saline springs near Daboiya; silver is recovered as a by-product of gold mining, and lime-burning is carried out on a small scale.

Iron ores are common but no large favourably situated deposits of high grade ore are known.

Cassiterite, together with a little molybdenite, wolfram and scheelite, occurs in pegmatites and aplites on the coast south-west of Accra, and with gold and columbite in beach and stream gravels in the same localities.

Large deposits of andalusite and kyanite are known near Bekwai, Ashanti; kyanite is also abundant in the Bole district, Northern Territories, and in places between Shama and Tarkwa.

Staurolite and garnet are very abundant in certain localities and large quantities of staurolite, together with ilmenite and rutile, are recovered from the Birim diamondfield gravels.

Copper-bearing minerals are fairly common, but no deposit of copper ore of economic importance has been discovered.

Mica is common, but most of the material is of small size and the larger sheets are usually of poor quality.

Deposits of limestone suitable for agricultural and building purposes and for the manufacture of cement are known, but most of them are unfavourably situated. There are many clays suitable for the manufacture of bricks, pottery, pigments and refractories. Glass sands and felspar are also plentiful.

Future Prospects of Mineral Development

Although it is probable that most of the obvious mineral deposits of major commercial importance, that is, those exposed at the surface and carrying encouraging values there, have already been discovered, it is nevertheless certain that many less obvious deposits remain to be discovered, for example, those that do not outcrop or are only partly exposed at the surface, those superficially leached of their valuable minerals, those in which the valuable minerals are locked up in sulphides, and gold ores in which the free gold is so finely divided that it cannot readily be detected by panning.

Several ore bodies of these types have been discovered during the past 15 years, the largest being the ore bodies between Marlu and Brumasi, and the richest a blind bonanza in the Cote d'Or reef channel at the Ashanti Mine, which contained between the tenth and thirteenth levels approximately 675,000 oz. of gold. In 1932 the writer stated: "One suspects the existence of ore-bodies composed mainly of massive or disseminated sulphides, but, owing to the difficulty of recognising the leached outcrops of such ore-bodies in the humid tropics, only one ore-body of the kind has been found—namely, Justice's."[1] Since then ore bodies of the same type have been found at Marlu, Bibiani, Sansu, Ayeinm and Nanwa mines.

It is likely that other ore bodies of the types mentioned above will be located during ordinary mining and prospecting operations, but, in general, it will be necessary to employ modern scientific methods of prospecting, including geological and geophysical surveys and intensive drilling, to locate them. Obvious opportunities for such investigations exist (*a*) along the main lode-gold channels, which have not yet been intensively prospected by modern methods, (*b*) in the Tarkwa goldfield where little is known of the disposition of the ore shoots in depth, (*c*) in the rocks under the cover of Voltaian sediments which in many places are only a few hundred feet thick, (*d*) in the oil-bearing Cretaceous rocks in the coastal area west of Axim, (*e*) in the vicinity of the known manganese deposits at Nsuta, and (*f*) in the flats and terraces of some of the large rivers for alluvial gold and diamonds. The gold ores associated with porphyry intrusions are worthy of further investigation; many ore bodies of this type are known, and, although only one, Bibiani, has so far developed into a big mine, there seems to be a reasonable chance of finding other payable ore bodies, especially large low-grade ones. There is also scope for more work in the Birrimian and younger granite areas of the Northern Territories. These areas have not yet been thoroughly prospected, and, as the Africans were not familiar with gold prospecting, there are no native workings to guide the prospector.

In the search for mineral deposits, attention should not be confined to the major ores, metals and precious stones, as it is likely that other minerals, especially some of the commoner ones, will be increasingly needed in the future for local use.

Post-war Geological Investigations

During the past 10 to 15 years the Gold Coast Geological Survey, in common with some of the other Colonial Geological Surveys, has worked under great difficulties owing to shortage of staff. The enormous growth of the mining industry from 1932 onwards and the formation of the Water-Supply Section in 1937, resulted in a very great increase in our work, but the European geological staff,

[1] *Gold Coast Government Sessional Paper No.* 1, 1933, p.4.

and the expenditure on the Survey, were not increased and were actually less, on the average, than during the period 1921-31.

The difficult conditions under which many of the Geological Surveys are working were appreciated by the Secretary of State for the Colonies, and in 1944 a Committee was appointed "to consider the needs for geological work in the Colonial Empire and the best organisation to carry it out." In their Report, the Committee recommended the re-organisation of the Geological Surveys on a regional basis and submitted proposals for a substantial expansion of geological work in the Colonies and for improving the status of geologists.

Water-supply, mineral, and mine investigations are likely to continue to be the principal work of the Gold Coast Geological Survey until the reorganisation of the Service is accomplished. The investigations should include geological and geophysical surveys for minerals and water; comprehensive surveys of mineralised areas, including the revision of the geological maps of the Ashanti and Prestea goldfields based on the revised topographical maps; detailed studies of the geological structures of the known mineral deposits to guide future prospecting and development; surveys of the resources of limestone, clay, sand, etc., for local use; and the prospecting and mapping of little-known and key areas. The systematic geological mapping of the whole of the Gold Coast, on a scale of 1 in. or ½ in. to the mile, should also be put in hand as soon as staff and topographical maps are available for this purpose.

Before concluding, the writer would like to pay tribute to the very valuable work carried out for the Colonial Geological Surveys in general, and for the Gold Coast Survey in particular, by the highly trained and experienced staff of the Mineral Resources Department of the Imperial Institute during the past 30 or 40 years. The results of their investigations have been of invaluable help to us as well as to other Surveys, Government Departments and companies, and have undoubtedly played an important part in the appraisal and development of the mineral resources of the Empire. It is hoped that the work of the Department will be considerably expanded in the near future.

The writer also wishes to express his thanks to the Director and staff of the Imperial Institute and to Mr. W. T. James, Superintendent of Records, Gold Coast Geological Survey, for their kind assistance in the preparation of this paper.

Discussion

The Chairman, **Sir Thomas Holland,** K.C.S.I., K.C.I.E., F.R.S., in introducing the lecturer, first expressed his appreciation of the enterprise undertaken by the Imperial Institute in bringing the mineral resources of the Colonies to the notice of the public (and by the audience, he saw it was the right kind of public). For the last six years, for very obvious reasons, the Imperial Institute

had been unable to publish its monographs and statistics of the mineral industry, which he thought had been relied upon by everyone as the one group of statistics that could be trusted for pure accuracy, and he hoped that they would soon reappear.

The Gold Coast was a conspicuous case where, although they had been relying up to relatively recently on vegetable products, they were now turning to the development of mineral resources which were independent of the vagaries of climate and of plant diseases. That was one reason, a good one, for the development of the mineral resources and the development of Geological Surveys in the Colonies. He hoped that publication of the report of the Colonial Office Committee on Colonial Geological Surveys would not be much longer delayed.

After alluding to the pioneer work of Sir Albert Kitson in the Gold Coast, he stressed the important contributions made to the war effort by the Gold Coast mineral industry.

The Chairman called upon **Mr. D. A. Thompson,** O.B.E., a Director of the African Manganese Co., Ltd., and former President of the Gold Coast Chamber of Mines, to open the discussion.

Mr. Thompson said it had been his good fortune to have known Dr. Junner during the whole of that officer's career in the Gold Coast and he was glad to have the opportunity of expressing to Dr. Junner and his staff the gratitude and indebtedness due to them for the services they had rendered to the mining industry and for the whole-hearted co-operation of the Geological Survey Department in helping the mining companies to solve many of their problems.

Among other topics, Mr. Thompson then briefly reviewed the achievements of the Gold Coast manganese industry, which, since shipments commenced in 1916, had exported 9 million tons of ore. He also disclosed that during the war-period production had been increased from around 400,000 tons per annum to about 750,000 tons per annum. Since 1940 practically the only source of supply of this raw material to Great Britain had been that from the Nsuta orebodies. The war-time steel production of both the United Kingdom and the U.S.A. had been largely dependent on this source of manganese, the importance of which could scarcely be exaggerated. A very high proportion of the manganese ore used in the dry batteries of our electric torches had also come from Nsuta.

During the last few years the revenue of the Gold Coast had derived over £1,000,000 annually from the mining industry. The wages paid by the industry amounted to £1,000,000 annually, and for some years the purchase of stores locally in the Colony had amounted to £800,000.

In conclusion Mr. Thompson pointed out the useful part played by the Mineral Resources Department of the Imperial Institute in furthering work on the development of the Colonial Empire, and stressed the need for the extension of that Department's activities.

Mr. C. E. Jobling, technical director and consulting engineer to several important Gold Coast mining companies, who first went to the Gold Coast in 1911, recounted certain instances of the shortcomings of mining people who had not taken the trouble to get information which was available for them at the Geological Survey Department. He compared the Gold Coast bañket with that of South Africa and observed that the pyrites of the latter was practically absent from the former. He asked Dr. Junner for his views on the source of the conglomeratic material forming the Gold Coast banket. The speaker thought it had come from the south because the pebbles were largest in the south and became smaller and smaller when traced in a north-north-easterly direction.

The Gold Coast Colony at one time had had the reputation of being the white man's grave. Although modern tropical hygiene had almost rendered that a thing of the past, it had to be borne in mind that the geologists still have to go right out into the rough, virgin country, which is just the same as it was in those days, and that they have to put up with all the difficulties that were incurred by the original pioneers. The geologists should be regarded as the pioneers of the outlying regions of these countries, and it was only comparatively recently that the governments of colonial tropical countries had realised the absolute importance of geological departments and the information and assistance obtained from them in opening up new lands.

Mr. J. Norman Wynne, after instancing special assistance he had received from the Geological Survey, mentioned that in his examination of the gold mines of the Gold Coast he saw far more graphite than in any of the other goldfields of the world he had visited. He asked Dr. Junner for an explanation of this fact.

Sir Lewis L. Fermor, after drawing some parallels between the geology and mineral resources of India with those of the Gold Coast, discussed some of the implications of Gondwanaland.

In his remarks of appreciation of Dr. Junner's lecture, **Sir Edmund Teale** was another speaker who touched upon the difficult conditions under which the geologist had to work in tropical parts of the Colonial Empire. These vary considerably according to climatic and other factors. The audience had seen from the lantern slides something of the dense forests, but, unless they had actually been there, they could scarcely appreciate either the difficulties of the dense undergrowth and forest growth which hampered the geologist at every turn or the infuriating habits of certain insects. Another concomitant of tropical conditions was the great blanket of lateritic rock that frequently masked the geology, particularly on hills and ridges. He was very glad Mr. Jobling had mentioned some of these difficulties because they were undoubtedly a factor in geological work in the tropics.

Replying to Mr. Jobling's question, **Dr. Junner** said that in the Tarkwa goldfield in particular they knew that the source of

the bulk of the material forming the banket lay to the south and south-east. Further north, however, the cross bedding and the composition and size of the pebbles often showed that the material came from the north-east.

In reply to Mr. Wynne, the lecturer stated that up to 6 per cent. of carbon had been deposited with the Birrimian sediments. The graphite of the goldfields was the result of the shearing of those carbonaceous sediments during the formation of the auriferous reefs. The shearing had resulted in polished graphitic surfaces which were particularly striking alongside the main reef channels, but the graphite was not really present in such quantity as at first sight it appeared to be.

After the showing of a short film on manganese mining, to which **Mr. D. A. Thompson** contributed a running commentary, and votes of thanks, the proceedings terminated.

A comprehensive collection of publications, maps and minerals of the Gold Coast was exhibited. The attendance numbered about 150.

ABSTRACTS AND NOTES

Obituary.—D. J. Davies. It is with deep regret that we record the death on March 31, 1946, of Daniel James Davies, C.B.E., J.P., B.Sc., F.R.I.C., Trade Commissioner for Newfoundland since 1934. Mr. Davies represented Newfoundland on the Board of Governors of the Imperial Institute from 1938, and was a member of the Advisory Council on Mineral Resources and of all the Mineral Consultative Committees of the Institute from 1943.

Born in 1880 in Carmarthenshire, he was educated at University College, Cardiff, where he studied metallurgy. His distinguished association with Newfoundland dates from his appointment in 1911 as Science Master at the Methodist College, St. John's. In the following year he became Government Chemist, a post he held until 1930 when he was appointed Acting High Commissioner for Newfoundland in London, becoming Trade Commissioner in 1934. Since 1936 he was also a Governor of the Imperial College of Science and Technology.

Mr. Davies represented Newfoundland at a number of international conferences and was a member of the Newfoundland Delegation to the Imperial Conference of 1930. He was appointed an Officier d'Académie (France) in 1928 and was a Fellow of the Chemical and Geological Societies and a Member of the Society of Public Analysts, London.

During his association of more than 25 years with the Institute, Mr. Davies was always most willing to give freely of his experience and advice and his valuable counsels will be greatly missed.

Large Magnetite Deposits in Tanganyika.—*The Liganga titaniferous magnetite deposits, Eastern Upangwa, Njombe District, Tanganyika, briefly mentioned in a previous number of this* BULLETIN (1945, **43**, 121), have been described by G. M. Stockley (*Min. Mag., Lond.*, 1945, **73**, No. 5, 265-274).

The deposits are situated near the north-eastern end of Lake Nyasa, Liganga Hill being about 70 miles E.S.E. of the northernmost point of the lake. They are surrounded by mountainous country, breached only by the Lupali and Msolwa Rivers, and lie on the Liganga-Maganga ridge, which extends for 13 to 14 miles between these two rivers. The nearest existing motor roads lie respectively 15 miles to the north-east, and 23 miles to the north-west, of Liganga Hill, but the route of a prospective motor road linking Mahenye with Manda on Lake Nyasa passes close to it.

The magnetite occurs as massive parallel seams within a crescent-shaped gabbroic body, which is intrusive into a mixed series of gneisses and allied types of the Basement System. The gabbroic body is strikingly leucocratic, except in the vicinity of the seams, where it becomes rich in magnetite, the junction rocks commonly being chloritic schists with euhedral magnetite crystals. Green chrome spinel is also associated with the magnetite.

The seams dip very steeply and are four, five or six in number in different areas of the gabbroic body. They strike in a general south-eastly direction, and are displaced by a number of dip-faults. The longest seam was detected over a distance of 11 miles; the widest was 600 ft. across and the narrowest 30 ft. The dip of the seams, and their closing in together at the western end of their outcrop, strongly suggest that they are disposed in the form of a steep syncline.

It is estimated that a minimum of 1,200,000,000 tons of magnetite is available, but this figure may be multiplied several times if the suggested synclinal structure of the seams is proved. In addition, there are a large number of displaced blocks lying barely covered by superficial deposits on the hill sides.

The magnetite is titaniferous, as shown by the two analyses of the ore that have been made:

	Maganga seam per cent.	*Liganga seam* per cent.
Fe	56·44	58·68
Ti	8·10	8·12
Mn	0·19	0·20
Cr	trace	trace
S	0·055	0·037
P	trace	trace
SiO_2	1·40	0·45

An analysis of a composite sample from 11 seams, for the titanium content only, showed 7·65 per cent. Ti. Precise determinations of phosphorus do not appear to have been made.

The two main requisites for the reduction of magnetite to iron are coke and limestone. The Ngaka and Ketewaka-Mchuchuma

coalfields of the Ruhuhu valley, the latter of which lies only 34 miles south-west of Liganga Hill, contain estimated reserves of 800,000,000 tons of coal, but the samples so far examined have been non-coking. As regards available limestones, there are large quantities of crystalline limestones of the Basement System both north and south of the coalfields, and Karroo limestones of small extent in the Ruhuhu depression.

The smelting of an iron ore containing some 12 per cent. TiO_2 is a difficult operation, and one which is undertaken only in exceptional circumstances. It can be performed successfully with ordinary limestone flux when the ore is mixed with three times the amount of haematite, and in the U.S.S.R. the reduction is reported to be accomplished without adding other ores, by using fluxes such as nepheline-syenite and rock salt. It is therefore noteworthy that syenite occurs at Mbosi and nepheline bearing volcanic rocks in the Rungwe District—rocks that it is thought might serve the purpose of nepheline-syenite. Salt is produced at Ivuna Pan, Lake Rukwa.

Should these deposits be exploited, the necessary railway linking them with the Ruhuhu coalfields and a port on Lake Nyasa could be constructed along the Ketewaka and Ruhuhu valleys, or the Ketewaka and Mchuchuma valleys. There are two sites near Liganga Hill suitable for the construction of an aerodrome. The whole region is well watered, but there are no rapids adequate for industrial hydro-electric plants. It seems probable that the Mdando Forest Reserve contains enough timber for the early stages of mine development, although little underground mining would appear to be required for some considerable time.

Preliminary investigations recommended are the completion of the prospect road from Mahenye to Manda via the Liganga region; a topographic survey of the Ketewaka valley and adjacent country, including the costing of a railway from the iron deposits to the lake; completion of a detailed geological survey of the area, and exploratory work in the surrounding country; and metallurgical research on the alkaline fluxing of titaniferous magnetites.

P. L. R.

Titanium and Vanadium in the Magnetic Iron Ores of the Bushveld Complex, South Africa.—In a paper under the above title in the *Transactions of the Geological Society of South Africa* (1944, **46**, 23-38), Dr. C. M. Schwellnus and Dr. J. Willemse describe the results of an investigation into the distribution and mode of occurrence of titanium and vanadium in the Bushveld iron ores.

The magnetic iron ores occur as magmatic segregations in the form of bands in the basic rocks of the Bushveld igneous complex. These bands are usually continuous for miles along the strike, the total length of which is about 110 miles, and probably persist to

great depths. Although it has been known for some time that these magnetic iron ores carry some titanium and vanadium, nothing was known as to the distribution of these elements in the different superimposed bands and along or across the strike of individual occurrences.

For the purposes of this investigation the bands of magnetic iron ore have been sampled at intervals over a strike distance of about 60 miles in the Rustenburg district. These samples were subjected to mineragraphic examination, chemical analysis, and concentration tests.

The minerals present are magnetite, ilmenite, spinel, a sulphide (apparently chalcopyrite), maghemite, haematite (martite), and occasional silicates and secondary minerals like goethite. Magnetite is a comparatively rare constituent, usually forming only 5 per cent. of the ore. Maghemite is the commonest and most widely distributed mineral in these ores. Although the ores carry from 0 to 1·5 per cent. V_2O_5 no definite mineral could be detected to account for the vanadium.

The following deductions appear permissible as the result of the chemical analyses.

(1) The vanadium pentoxide (V_2O_5) content of the ores as a whole varies from 0 to 1·5 per cent. The lower band in the principal group of bands contains the most vanadium.

(2) The titanium dioxide (TiO_2) content varies from 8 per cent. to 24 per cent. The lower band in the principal group of bands carries on an average the least titanium.

(3) There is an antipathetic relation between the titanium and vanadium contents. While there is an increase in titanium in the upward succession in the principal group of bands, the vanadium decreases correspondingly. There is thus an antipathetic relation between the curves for V_2O_5 and for ilmenite. On the other hand there is a sympathetic relation between the V_2O_5 content and the normative haematite plus magnetite value of the ore.

(4) It follows from (3) that the V_2O_5 is contained in the magnetite (or maghemite) and not in the ilmenite. This contention is further supported by the fact that the V_2O_5 content shows a considerable increase in the magnetic fractions of the magnetically separated ore.

(5) Across individual bands of ore there is no appreciable variation of either vanadium or titanium.

(6) The Cr_2O_3 content of the ore is generally low and often nil, a maximum of 1·0 per cent. being recorded. There appears to be a concentration of chromium in the ore from the critical zone and in the lower band of the principal group, with a general decrease or disappearance upwards. The trend of the Cr_2O_3 values is thus, in general, the same as that of the V_2O_5, and the chromium is also considered to be associated with the magnetite (maghemite) rather than with the ilmenite. This contention is also borne out by the analytical results of the magnetically separated portions.

(7) Manganese, which ranges from 0·07 to 0·43 per cent. MnO, seems to increase slightly towards the upper horizons.

(8) The phosphorus content of the ore is said to be generally very low, just how low, however, is open to question as this element is returned in most of the analyses as a trace.

In view of the intimate association of the minerals in this ore, it seems very doubtful whether the vanadium can be concentrated by a physical method. After polished sections had been examined and the amount of granular ilmenite determined with the integrating stage, some samples were crushed, sieved, and subjected to separation by a hand magnet, the non-magnetic fractions being chemically examined. The following conclusions are drawn from the results of the concentration tests:

(1) The modal percentage of granular ilmenite is the only indication of the possible amount of magnetically separable ore. The TiO_2 content has very little bearing on this point, owing, it seems, to the fact that ilmenite is probably not all exsolved from the magnetite in some cases.

(2) An 80-mesh sieve proved the most suitable.

(3) Unweathered pure ore is desirable, since secondary minerals and silicates go with the ilmenite fraction on concentration.

(4) The non-magnetic concentrate obtained in each case was very impure.

(5) The Cr_2O_3 and V_2O_5 contents of the non-magnetic fraction are low.

It is concluded that, should the Union of South Africa have to become independent of foreign supplies, it may be worth investigating the processes of separating the vanadium from the ore. As regards reserves, it has already been stated that the lower band of the principal group of bands of magnetic iron ore carries the highest vanadium values, and an estimate based on the assumptions that this band is 3 ft. thick, persists for 100 ft. along the dip, and is uniform in composition at 1·25 per cent. V_2O_5, indicates that the known occurrences of this band alone will yield in round figures 1,000,000 tons V_2O_5.

As regards titania, the Bushveld deposits can in no way compete as far as grade of ore is concerned with the Travancore beach deposits, but the TiO_2 content compares favourably with other deposits of similar nature. An analysis of the concentrates from the deposits in the critical zone of the Lydenburg area shows 42·7 per cent. TiO_2 and is claimed to be equal to the best quality concentrates from Norway and Russia. Only a relatively small portion of the magnetic iron ores of the Bushveld complex has been investigated. and it is very likely that, if a more detailed field and laboratory investigation were carried out, the reserves of magnetic iron ore containing granular ilmenite in recoverable amounts might prove to be immense.

A. W. G.

BOOK REVIEWS

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

RAW MATERIALS FROM THE SEA. By E. Frankland Armstrong, D.Sc., F.R.S., and L. Mackenzie Miall, B.A. Pp. xi + 164, $8\frac{1}{2} \times 5\frac{1}{2}$. (Leicester: Constructive Publications, Ltd., 1945.) Price 15s.

The conception that the oceans constitute an integral part of the world's mineral resources is one that is hardly ever taken into consideration. Yet the oceans form a vast storehouse of inorganic salts of widely varying types, each cubic mile of ocean (and there are 300 million cubic miles in all) containing some 166 million tons of dissolved salts. It has been computed that these include:

	Tons.
Sodium chloride	128,284,403
Magnesium chloride	17,946,522
Magnesium sulphate	7,816,053
Calcium sulphate	5,939,747
Potassium sulphate	4,068,255
Calcium carbonate	579,832
Magnesium bromide	358,270
Fluorine	1,374
Barium	916
Iodine	100 to 12,000
Arsenic	45 to 367
Rubidium	198
Silver	up to 45
Gold	23
Radium	5 *grams*

Until comparatively recently, no major raw material has been drawn from this vast storehouse except salt, the world's first industrial product. Bromine, however, was produced from natural brines in America as long ago as 1848, though world production has only assumed importance during the past few decades. Thus, production in the United States (the world's principal producer of bromine) in 1914, amounted to only 576,991 lb.; in 1924, it was 2,033,804 lb.; in 1933, 10,147,960 lb.; in 1935, 16,428,533 lb.; and in 1942, 65,880,935 lb. To-day it may be said that any scarcity or monopoly of bromine has been ended for ever.

Similarly, widespread interest has been aroused in recent years by the winning, in large quantities on an economic basis, of magnesium as hydroxide from the sea. The development of the industry in the United Kingdom, United States and Canada has been closely connected with the two major wars of this century, largely as a result of the growth of the aircraft industry. Despite the huge consumption of magnesium for war purposes, more was recovered from the sea than could be consumed, and before hostilities ceased last year several new plants had to be scrapped.

It is to be expected that other elements will be won directly from the sea in the future; as it is, several are to-day obtained

from deposits representing dried up ancient seas or those, like the Dead Sea, which are only partially evaporated.

The authors of the book under review have wisely brought together for the first time such information as is available concerning the winning of those substances which come either directly or indirectly from the sea, at the same time prefacing it by a general reference to the chemical problems which the oceans present and to the various elements that are found in them in minor quantities. Such a study involves several sciences other than chemistry, and the perusal of a widely scattered literature. The result is an eminently readable and well-illustrated little book by two well-known industrial scientists, one of whom (Dr. Armstrong) was formerly closely connected with the Imperial Institute, and whose untimely death was reported in this BULLETIN (1945, **43**, 322).

The subject matter is divided into nine chapters entitled: Something about the oceans; chemicals in the sea; the biochemistry of the oceans; solar salt; bromine from the sea; magnesium from the sea; iodine and the seaweed industry; potassium salts; and potable water from sea water. There is an appendix on analytical methods designed to give sufficient details to convince the reader of the reliability and accuracy of the chemical methods employed, and to refer the analyst to the original papers if interested. The work concludes with a useful index.

E. H. B.

A DICTIONARY OF METALLOGRAPHY. By R. T. Rolfe, F.R.I.C. Pp. viii + 243, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Chapman & Hall, Ltd., 1945.) Price 15*s*.

Metallography is that branch of science which deals with the constitution and structure of metals and alloys, and the relationship of these characteristics to their properties. It covers, therefore, the physical aspects of metallurgy, as distinct from chemical metallurgy which deals with the extraction of metals from their ores, their refining and processing for use.

The present work is concerned with the definition of the principal terms used in metallography, especially with atomic structure, constitution, micrography and macrography, processing, heat-treatment, testing of all kinds, and effects arising in service. In point of fact, however, most of the entries are much more than mere definitions and the book is more than a dictionary, but nowhere is conciseness and clarity sacrificed on that account.

Some users would probably find the present work even more useful if, under such entries as elongation, tensile strength, hardness testing, etc., short tables were given showing the values of these properties for some of the common metals and alloys. There are, indeed, precedents for this within the book itself.

Mr. Rolfe's new work, which is competently and adequately executed, is probably the first dictionary on this subject which has

yet appeared in this country, and forms a handy and useful addition to the reference books for those concerned with any aspect of physical metallurgy.

E. R. V.

BIBLIOGRAPHY

Compiled by Miss J. M. Cullinan, B.A.

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the three months, November 1945–January 1946.

The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1. Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.

OFFICIAL ANNUAL REPORTS

United Kingdom: Twenty-third Annual Report of the Safety in Mines Research Board, 1944. *Ministry of Fuel and Power.* Pp. 30, 6 × 9½. (London: H.M. Stationery Office, 1945.) Price 1*s.*

Nigeria: Annual Report on the Geological Survey Department for the year 1944. Pp. 16, 6¾ × 9¾. (Lagos: Government Printer, 1945.) Price 1*s.*

Union of South Africa: Twelfth Annual Report of the Fuel Research Board for the year ended December 31, 1942. *Fuel Res. Inst. S. Afr.* Pp. 52, 9½ × 6. (Pretoria: Government Printer, 1944.) Price 3*s.* 6*d.*

Union of South Africa: Thirteenth Annual Report of the Fuel Research Board for the year ended December 31, 1943. *Fuel Res. Inst. S. Afr.* Pp. 47, 9½ × 6. (Pretoria: Government Printer, 1945.) Price 4*s.*

Ceylon: Administration Report of the Government Mineralogist for 1944. Pp. 12, 13 × 8. (Colombo: Department of Mineralogy, June, 1945.)

Victoria: Annual Report of the Department of Mines, including Gold and Mineral Statistics and Boring Records, for the year 1944. Pp. 26, 13 × 8¼. (Melbourne: Government Printer, 1945.)

Western Australia: Report of the Government Geologist for the year 1943. *Dep. Mines, W. Austr.* Pp. 32, 13 × 8. (Perth: Government Printer, 1944.)

South Australia: Mining Review, No. 81, for the half-year ended December 31, 1944. *Dep. Mines, S. Austr.* Pp. 111, 9½ × 6. (Adelaide: Government Printer, 1945.)

New Zealand: Mines Statement [for the year ended December 31, 1944]. Pp. 38, 13½ × 8½. (Wellington: Government Printer, 1945.) Price 1*s.*

New Zealand: State Coal Mines. (Report on the Working of) for the year ended March 31, 1945. Pp. 19, 13½ × 8½. (Wellington: Government Printer, 1945.) Price 9*d.*

MINING LAW

United Kingdom: S.R. and O. No. 1217. The Coal Mines (Training) General Regulations, 1945. *Ministry of Fuel and Power.* Pp. 10, 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 3*d.*

United Kingdom: S.R. and O. No. 1350. The Quarries General Regulations (Electricity), 1945. *Ministry of Fuel and Power.* P. 1, 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 1*d.*

United Kingdom: S.R. and O. No. 1351. The Metalliferous Mines

General Regulations, 1945. *Ministry of Fuel and Power.* P. 1, 9½ × 6. (London : H.M. Stationery Office, 1945.) Price 1*d.*

Nigeria : Minerals Ordinance, 1945. *Suppt. Nigeria Gaz.*, 1945, **32,** No. 72, 2367-2434.

COMMERCIAL INTELLIGENCE

The Metal Industry Handbook and Directory, 1945, No. 34. Pp. 476, 8¾ × 6. (London : Louis Cassier Co., Ltd., 1945.)

The Chamber of Mines of Rhodesia (Incorporated) : Sixth Annual Report for the year 1944. Pp. 50, 9½ × 7½. (Bulawayo : Rhodesian Printing and Publishing Company, Ltd., 1945.)

Annuaire International des Minerais et Métaux. Édition 1944. By R. Pitaval and R. Sevin. Pp. 360, also six supplements of 32, 64, 96, 126, 160 and 192 pp. respectively, 9½ × 6. (Paris : Société des Publications Minières et Métallurgiques, 1944.)

France : Organisation du Service des Mines au Ministère des Colonies. *Écho Min. Métall.*, 1945, No. 3366, 85-86.

Sweden : Bergshantering Berättelse för år 1940 av Kommerskollegium. *Sver. Offic. Stat., Industr. och Bergs.* Pp. 67, 9½ × 6½. (Stockholm : K. L. Beckmans Boktryckeri, 1942.)

Sweden : Bergshantering Berättelse för år 1941 av Kommerskollegium. *Sver. Offic. Stat., Industr. och Bergs.* Pp. 69, 9½ × 6½. (Stockholm : K. L. Beckmans Boktryckeri, 1943.)

Sweden : Bergshantering Berättelse för år 1942 av Kommerskollegium. *Sver. Offic. Stat., Industr. och Bergs.* Pp. 71, 9½ × 6½. (Stockholm : K. L. Beckmans Boktryckeri, 1944.)

Sweden : Bergshantering Berättelse för år 1943 av Kommerskollegium. *Sver. Offic. Stat., Industr. och Bergs.* Pp. 73, 9½ × 6½. (Stockholm : K. L. Beckmans Boktryckeri, 1945.)

GEOLOGY AND MINERAL RESOURCES

Annotated Bibliography of Economic Geology for 1943. *Soc. Econ. Geol.* Pp. 126, 6¾ × 9½. (Urbana, Illinois : Economic Geology Publishing Company, July, 1945.)

The Cult of the Indeterminate ; Whither " Replacement " ? By W. J. Bichan. *Econ. Geol.*, 1945, **40,** No. 6, 416-424, with references,

The Concept of Ore Reserves. By S. G. Lasky. *Min. and Metall.*, 1945, **26,** No. 466, 471-474.

Principles and Application of Refractometry. By O. McKay-Ferguson and B. W. Anderson. *Gemmologist*, 1945, **15,** No. 172, 19-20.

Sources of Information on the Geology of the Anglo-Egyptian Sudan. By G. Andrew. *Bull. No.* 3. Pp. 36, 9½ × 6½, and map. (Khartoum : Sudan Government Geological Survey, 1945.) Price P.T. 20 or 4*s.*

Kenya : Geological Survey of Eastern Maramma and Adjoining Areas, Western Kakamega, Northern Kavirondo. By W. Pulfrey. *Rep. No.* 8, *Min. Geol. Dep., Kenya.* Pp. 38, 10 × 7½, and map. (Nairobi : Government Printer, 1945.) Price Sh. 2.

The Canadian Mineral Industry in 1944. Reviews by the Staff of the Bureau of Mines. *Bur. Mines Publ. No.* 815, *Mines Geol. Br., Canada Dep. Mines Res.* Pp. 103, 9¾ × 6½. (Ottawa : King's Printer, 1945.)

Geology of Red Deer and Rosebud Sheets, Alberta. By J. A. Allan and J. O. G. Sanderson. *Rep. No.* 13, *Res. Counc. Alberta.* Pp. 109, 6½ × 10, and maps. (Edmonton : King's Printer, 1945.) Price 75 cents.

The Coast Range Batholith near Vancouver, British Columbia. By T. C. Phemister. *Quart. J. Geol. Soc. Lond.*, 1945, **101,** Pts. 1 and 2, 37-88, and plate.

The Dawson River Area. By J. H. Reid. *Queensland Govt. Min. J.*, 1945, **46,** No. 528, 296-299.

The San Telmo Ore Body, Spain. By J. C. Allan. *Bull. Instn. Min. Metall., Lond.*, 1946, No. 476, 15 pp.

Notes on the Mineral Wealth of Egypt. By Prof. Holman. *Min. J.*, 1945, **225**, No. 5753, 798-799.

Geology and Biology of North Atlantic Deep-Sea Cores between Newfoundland and Ireland. Part 9. Selenium Content and Chemical Analyses. By G. Edgington and H. G. Byers. *Prof. Pap. No.* 196-*F, U.S. Geol. Surv.* Pp. xv + 5, 11½ × 9. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 15 cents.

Bibliography of North American Geology, 1929-1939 (2 volumes). Part 1, Bibliography. Part 2, Index. By E. M. Thom. *Bull. No.* 937, *U.S. Geol. Surv.* Pp. 1546, 5¾ × 9. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1944.) Price $2.50 (complete).

Bibliography of North American Geology for 1940 and 1941. By E. M. Thom. *Bull. No.* 938, *U.S. Geol. Surv.* Pp. 479, 5¾ × 9. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 50 cents.

Stratigraphy, Structure, and Mineralization in the Beaver-Tarryall Area, Park County, Colorado. By Q. D. Singewald. *Bull. No.* 928-*A, U.S. Geol. Surv.* Pp. 44, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 15 cents.

Stratigraphy and Fauna of the Louisiana Limestone of Missouri. By J. S. Williams. *Prof. Pap. No.* 203, *U.S. Geol. Surv.* Pp. 133, 11½ × 9. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1943.) Price 50 cents.

Stratigraphic Control of Orebodies in Montana. By E. S. Perry. *Engng. Min. J.*, 1945, **146**, No. 10, 96-98.

Geology of the Hanover-York District, Pennsylvania. By A. J. Stose and G. W. Stose. *Prof. Pap. No.* 204, *U.S. Geol. Surv.* Pp. 82, 11½ × 9, and map. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1944.) Price $1.75.

The Basin and Range Province in Utah, Nevada, and California. By T. B. Nolan. *Prof. Pap. No.* 197-*D, U.S. Geol. Surv.* Pp. 56, 11½ × 9. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1943.) Price 15 cents.

On the Structure of the Arabian Peninsula. By L. Picard. *Bull. Geol. Dep., Hebr. Univ., Jerusalem*, 1937, **1**, No. 3. Pp. 9, and maps.

The Pre-Cambrian of the North Arabian-Nubian Massif. By L. Picard. *Bull. Geol. Dep., Hebr. Univ., Jerusalem*, 1941, **3**, No. 3-4. Pp. 30.

On the Geology of the Central Coastal Plain. By L. Picard and M. Avnimelech. *Bull. Geol. Dep., Hebr. Univ., Jerusalem*, 1937, **1**, No. 4. Pp. 45, and maps.

The Geology of New Jerusalem. By L. Picard. *Bull. Geol. Dep., Hebr. Univ., Jerusalem*, 1938, **2**, No. 1. Pp. 12, and maps.

Geological Study of the Region between Gemlik and Bursa, Turkey. By A. Suat Erk. *Maden Tetkik ve Arama*, 1944, No. 9, i-xiv (in Turkish), 1-278 (in French).

PROSPECTING AND MINING METHODS

(*See also under Metals and Non-Metals.*)

Mining at Depth or at Great Heights. By W. Schweisheimer. *Min. Mag., Lond.*, 1946, **74**, No. 1, 27-28.

Aeroprospecting in the Yellowknife Area. By A. W. Jolliffe. *Canad. Min. Metall. Bull.*, 1945, No. 401, 588-604.

Tunnelling in Gibraltar during the 1939-45 War. By W. H. Wilson. *Bull. Instn. Min. Metall., Lond.*, 1945, No. 475, 33 pp.

Shaft Sinking. Description of Operations from Surface to Coal Seam.

By J. S. Downie. *Iron Coal Tr. Rev.*, 1946, **152**, No. 4063, 55-59; No. 4064, 97-100.

Shaft Sinking by Rotary Drilling. By D. H. Platt. *Inform. Circ. No.* 7336, *U.S. Bur. Mines.* Pp. 14, 10½ × 8, diagrams and photographs. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Aerial Ropeways: Their Importance and their Advantages. *Min. J.*, 1945, **225**, No. 5752, 780-782.

Electric Core Drills Stope Sudan's Hard Ore. *Engng. Min. J.*, 1945, **146**, No. 10, 73-80.

Long Hole Leyner Drilling Speeds Stope Preparation. *Engng. Min. J.*, 1945, **146**, No. 11, 82-84.

The Application of Double Packing on Longwall Roadways. Report of the Safety in Mines Research Committee of the North Staffordshire Institute of Mining Engineers. *Trans. Instn. Min. Engrs., Lond.*, 1945, **104**, Pt. 10, 512-546, with photographs and discussion.

Guarding Trolley Wires in Mines. By E. J. Gleim. *Inform. Circ. No.* 7332, *U.S. Bur. Mines.* Pp. 19, 10½ × 8, and diagrams. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Trackless Mobile Equipment Reduces Mining Costs. By H. O. Gray. *Engng. Min. J.*, 1945, **146**, No. 11, 97-99.

Pneumatic Stowing at Bullcroft Main Colliery. By J. Hunter. *Iron Coal Tr. Rev.*, 1945, **151**, No. 4060, 985-989.

Coyote Blast at Mount Morgan. By A. L. Lloyd. *Chem. Engng. Min. Rev.*, 1945, **38**, No. 445, 13-18.

Off Peak Pumping and Hoisting at Powell Rouyn Mines. By D. S. Johnson and W. H. Burns. *Canad. Min. J.*, 1945, **66**, No. 11, 781-783.

Chain-Conveying in Deep Seams. By R. W. Scurfield. *Trans. Instn. Min. Engrs., Lond.*, 1945, **104**, Pt. 10, 547-556, with photographs and discussion.

Double Cutting, and a New Application of a Short Chain Conveyor. By C. G. Widdas. *Iron Coal Tr. Rev.*, 1945, **151**, No. 4054, 711-715.

Lancashire Man-Riding Haulage Practice. By A. Wright. *Trans. Instn. Min. Engrs., Lond.*, 1945, **104**, Pt. 10, 566-589, with photographs and discussion.

Some Recent Researches on Explosions in Mines. By H. F. Coward. *Iron Coal Tr. Rev.*, 1945, **151**, No. 4061, 1019-1023. A review of progress in Belgium, France, U.S.A. and Britain.

Effect of Pressure on the Explosibility of Acetylene-Water Vapor, Acetylene-Air and Acetylene-Hydrocarbon Mixtures. By G. W. Jones, R. E. Kennedy, I. Spolan and W. J. Huff. *Rep. Invest. No.* 3826, *U.S. Bur. Mines.* Pp. 17, 10½ × 8, and diagrams. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Coal Face Supports—Props and Lids. Memorandum by the Yorkshire Advisory Committee on Falls of Ground. *Safety Pamphlet No.* 18, *Ministry of Fuel and Power.* Pp. 12, 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 2*d*.

Roof-control Research and Practical Application. By A. Winstanley. *Trans. Instn. Min. Engrs., Lond.*, 1945, **104**, Pt. 9, 430-441.

Dust in Return Roadways. A Review of Causes and Available Means for its Suppression. By W. A. Terrell. *Iron Coal Tr. Rev.*, 1945, **151**, No. 4058, 885-889; No. 4059, 935-938.

Use of Salts to Allay Dust on Shuttle-Car Roadways in Coal Mines. By E. Thomas and I. Hartman. *Rep. Invest. No.* 3828, *U.S. Bur. Mines.* Pp. 15, 10½ × 8, and graphs. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Aluminium Therapy in Silicosis. *Proc. Austr. Inst. Min. Metall.* (*Inc.*), 1945, No. 138 (N.S.). Pp. 148, 5½ × 8½.

CONCENTRATION AND METALLURGY

(*See also under Metals and Non-Metals.*)

Ball Wear in Wet Grinding Mills. By N. A. MacLeod. *A.I.M.E. Tech. Pub. No.* 1918, 7 pp. *Min. Tech.*, 1945, **9**, No. 6, with tables.

The Coal-Pulverising Plant at the McGill Smelter of the Kennecott Copper Corporation. By E. Pesout. *A.I.M.E. Tech. Pub. No.* 1822, 6 pp. *Min. Tech.*, 1945, **9**, No. 6, with diagrams.

Improved Laboratory Concentration Table. By W. H. Coghill, G. T. Adams and H. S. Hardman. *Rep. Invest. No.* 3831, *U.S. Bur. Mines.* Pp. 3, 10½ × 8, and photographs. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Table Flotation. By F. B. Michell. *Min. Mag., Lond.*, 1945, **73**, No. 6, 329-337.

METALS

Aluminium and Bauxite

Alumina from Clay. *Chem. Engng. Min. Rev.*, 1945, **38**, No. 446, 41-42.

Notes on a Graphical Method for the Approximate Determination of Alumina and Water in a Gold Coast Deposit. By W. Mankovsky. *Bull. Instn. Min. Metall., Lond.*, 1945, No. 475, 10 pp.

The Application of the Ternary Diagram to Arkansas Bauxite. By J. R. Thoenen, M. C. Malamphy and G. K. Dale. *A.I.M.E. Tech. Pub. No.* 1915, 13 pp. *Min. Tech.*, 1945, **9**, No. 6, with charts.

Chromium

Chrome Resources of Cuba. By T. P. Thayer. *Bull. No.* 935-*A*, *U.S. Geol. Surv.* Pp. 74, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price $1.

Chromite and Quicksilver Deposits of the Del Puerto Area, Stanislaus County, California. By H. E. Hawks, Jun., F. G. Wells and D. P. Wheeler, Jun. *Bull. No.* 936-*D*, *U.S. Geol. Surv.* Pp. 32, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 30 cents.

Geology of the Grey Eagle and some nearby Chromite Deposits in Glenn County, California. By G. A. Rynearson and F. G. Wells. *Bull. No.* 945-*A*, *U.S. Geol. Surv.* Pp. 22, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1944.) Price 50 cents.

Cobalt

Cobalt-Bearing Manganese Deposits of Alabama, Georgia and Tennessee. By W. G. Pierce. *Bull. No.* 940-*J*, *U.S. Geol. Surv.* Pp. 21, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1944.) Price 20 cents.

Columbium

Regular Intergrowth of Samarskite and Columbite from the Ilmen Mountains. By D. P. Grigoriev. *Mém. Soc. Russe Minéral., 2ième Série*, 1945, **74**, No. 1, 57-61. [In Russian with English summary.]

On the Pyrochlore from the Vishneviye Mountains in the Urals. By A. A. Ivanov, I. B. Borovsky and I. A. Yaroch. *Mém. Soc. Russe Minéral., 2ième Série*, 1944, **73**, No. 1, 56-58. [In Russian with English summary.]

Copper

The Nickel-Copper Mining, Smelting and Refining Industry in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 15, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1945.) Price 25 cents.

The New Horadiam Method of Mining at Copper Mountain, B.C. By R. S. Douglas, C. H. Brehaut, W. N. Taylor and H. A. Shannon. *Canad. Min. J.*, 1945, **66**, No. 11, 773-780; No. 12, 859-867.

Mount Cannindah Copper. By A. K. Denmead. *Queensland Govt. Min. J.*, 1945, **46**, No. 528, 302.

Magnetic Exploration of the Nickel-Copper Deposits of Bohemia Basin, South-Eastern Alaska. By M. S. Walton and G. C. Kennedy. *Econ. Geol.*, 1945, **40**, No. 7, 496-502.

Gold

Gold Recovery by Jig. Advantages for Small Workings. By L. L. Colin. *S. Afr. Min. Engng. J.*, 1945, **56**, Pt. 2, No. 2752, 231-233.

Working Costs and Gold Mining. An Analysis of the Effects of War. By A. Stuart. *S. Afr. Min. Engng. J.*, 1945, **56**, Pt. 2, No. 2752, 235-237.

Research in Rand Mining. By J. T. McIntyre. *J. Chem. Metall. Min. Soc. S. Afr.*, 1945, **46**, Nos. 1 and 2, 3-45, with references and discussion.

Notes on the Development of the Blyvooruitzicht Gold Mining Co., Ltd., South Africa. By A. Savile Davis. *Bull. Instn. Min. Metall., Lond.*, 1945, No. 475, 15 pp.

The Gold Mining Industry in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 76, 11½ × 9. (Ottawa: Department of Trade and Commerce, 1945.) Price 50 cents.

The Geology of the Central Patricia Mine, Ontario. By H. Brodie Hicks. *Precambrian*, 1945, **18**, No. 11, 7-9, 29.

The Future for Prospecting in the Pickle Lake—Crow River Area. By H. C. Horwood. *Precambrian*, 1945, **18**, No. 11, 4-6.

Geology of the Pickle Crow Gold Mine, Ontario. By H. H. Monette. *Precambrian*, 1945, **18**, No. 10, 6-10.

Report on Gold Belts in the Little Long Lac Sturgeon River District. By A. E. Tyson. *Canad. Min. J.*, 1945, **66**, No. 12, 839-850.

Operations of Victoria Gold Dredging Co., N.L. [Victoria, Australia]. *Chem. Engng. Min. Rev.*, 1945, **38**, No. 446, 39-40.

The Discoveries of Native Gold in the Dashkesan Deposits. By M. A. Karasic. *Mém. Soc. Russe Minéral., 2ième Série*, 1945, **74**, No. 2, 163. [In Russian.]

Venezuela—The Guayana Highlands. Gold Deposits of the State of Bolivar. By J. C. Davey. *Min. Mag., Lond.*, 1945, **73**, No. 6, 338-343.

Gold Mines of the Philippines. Early Resumption of Production. *S. Afr. Min. Engng. J.*, 1945, **56**, Pt. 2, No. 2756, 355-357.

Iron and Steel

Determination of Metallic Iron and Oxygen in Sponge Iron. By J. P. Morris. *Rep. Invest. No.* 3824, *U.S. Bur. Mines.* Pp. 31, 10½ × 8, and diagrams. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Electrolytic Manganese in Stainless-Steel Tests at Rustless Steel Corp. and Universal-Cyclops Steel Corp. By R. T. C. Rasmussen. *Rep. Invest. No.* 3829, *U.S. Bur. Mines.* Pp. 35, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Production of Sponge Iron in a Shale-Brick Plant. By D. W. Ross. *Rep. Invest. No.* 3822, *U.S. Bur. Mines.* Pp. 27, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Amine Flotation of Gangue from Magnetite Concentrates. By D. W. Scott, A. C. Richardson and N. Arbiter. *A.I.M.E. Tech. Pub. No.* 1902, 10 pp. *Min. Tech.*, 1945, **9**, No. 6, with tables.

Reduction of Iron Ore in Clay and Steel Containers (Saggers). By J. P. Walker. *Rep. Invest. No.* 3819, *U.S. Bur. Mines.* Pp. 30, 10½ × 8.

(Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Canada: The Miscellaneous Iron and Steel Products Industry, 1943. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 7, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1945.) Price 25 cents.

Lead and Zinc

Flexible Flowsheet Treats Varying Lead-Zinc Ore. By C. E. Craven. *Engng. Min. J.*, 1945, **146**, No. 11, 85-89.

Amine Flotation of Sphalerite-Galena Ores. By H. K. Kellogg and H. Vásquez-Rosas. *A.I.M.E. Tech. Pub. No.* 1906, 23 pp. *Min. Tech.*, 1945, **9**, No. 6, with graphs and references.

Microchemical Analysis of Sphalerite from Kristineberg, Sweden. By A.-G. Hybbinette. *Industr. Engng. Chem.* (*Anal. Ed.*), 1945, **17**, No. 10, 654-661, with references.

Structural and Stratigraphic Control of Zinc Deposits in East Tennessee. By J. Crawford. *Econ. Geol.*, 1945, **40**, No. 6, 408-415.

Lithium

The Tin-Spodumene Belt of the Carolinas. Preliminary Report. By T. L. Kesler. *Bull. No.* 936-*J, U.S. Geol. Surv.* Pp. 25, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 50 cents.

Magnesium

Olivine, a Suggested Source of Magnesia. By G. W. Pawel. *J. Amer. Ceram. Soc.*, 1945, **28**, No. 12, 360-362.

Manganese

Manganese Deposits of Cuba. By C. F. Park, Jun. *Bull. No.* 935-*B, U.S. Geol. Surv.* Pp. 23, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 10 cents.

Cobalt-Bearing Manganese Deposits of Alabama, Georgia and Tennessee. By W. G. Pierce. *Bull. No.* 940-*J, U.S. Geol. Surv.* Pp. 21, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1944.) Price 20 cents.

Manganese Deposits in the Paymaster Mining District, Imperial County, California. By J. B. Hadley. *Bull. No.* 931-*S, U.S. Geol. Surv.* Pp. 15, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 30 cents.

Occurrence of Manganese in Eastern Aroostook County, Maine. By W. S. White. *Bull. No.* 940-*E, U.S. Geol. Surv.* Pp. 36, 5¾ × 9. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1943.) Price 25 cents.

The Three Kids Manganese District, Clark County, Nevada. By C. B. Hunt, V. E. McKelvey and J. H. Wiese. *Bull. No.* 936-*L, U.S. Geol. Surv.* Pp. 23, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 30 cents.

Manganiferous and Ferruginous Chert in Perry and Lewis Counties, Tennessee. By E. F. Burchard. Concentration Tests on Manganese from Perry County. By H. S. Rankin. *Bull. No.* 928-*D, U.S. Geol. Surv.* Pp. 52, 5¾ × 9. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1943.) Price 25 cents.

Manganese Deposits of the Cedar Creek Valley, Frederick and Shenandoah Counties, Virginia. By W. H. Monroe. *Bull. No.* 936-*E, U.S. Geol. Surv.* Pp. 31, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 35 cents.

Manganese Resources of the Olympic Peninsula, Washington. Preliminary Report. By C. F. Park, Jun. *Bull. No.* 931-*R*, *U.S. Geol. Surv.* Pp. 23, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 35 cents.

Mercury

Conserving and Reclaiming Mercury. By A. G. Arend. *Chem. Age*, 1945, **53**, No. 1379, 513-515.

United Kingdom: S.R. and O. No. 1229. The Control of Mercury (No. 11) Order, 1945. *Ministry of Supply.* Pp. 4, 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 1*d*.

Quicksilver Deposits near the Little Missouri River, Pike County, Arkansas. By D. Gallagher. *Bull. No.* 936-*H*, *U.S. Geol. Surv.* Pp. 31, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 55 cents.

Quicksilver Deposits of the Parkfield District, California. By E. H. Bailey. *Bull. No.* 936-*F*, *U.S. Geol. Surv.* Pp. 27, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 35 cents.

Chromite and Quicksilver Deposits of the Del Puerto Area, Stanislaus County, California. By H. E. Hawks, Jun., F. G. Wells, and D. P. Wheeler, Jun. *Bull. No.* 936-*D*, *U.S. Geol. Surv.* Pp. 32, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 30 cents.

The Wild Horse Quicksilver District, Lander County, Nevada. By C. H. Dane and C. P. Ross. *Bull. No.* 931-*K*, *U.S. Geol. Surv.* Pp. 20, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 25 cents.

Nickel

Relative Abundance of Nickel in the Earth's Crust. By R. C. Wells. *Prof. Pap. No.* 205-*A*, *U.S. Geol. Surv.* Pp. 19, 11½ × 9. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1943.) Price 10 cents.

Polarographic Determination of Nickel in Steel and Nickel Ore. By P. W. West and J. F. Dean. *Industr. Engng. Chem.* (*Anal. Ed.*), 1945, **17**, No. 11, 686-688.

The Nickel-Copper Mining, Smelting and Refining Industry in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 15, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1945.) Price 25 cents.

Magnetic Exploration of the Nickel-Copper Deposits of Bohemia Basin, South-Eastern Alaska. By M. S. Walton and G. C. Kennedy. *Econ. Geol.*, 1945, **40**, No. 7, 496-502.

Nickel-Silicate and Associated Nickel-Cobalt-Manganese-Oxide Deposits near São José do Tocantins, Goiaz, Brazil. By W. T. Pecora. *Bull. No.* 935-*E*, *U.S. Geol. Surv.* Pp. 32, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1944.) Price $1.

Rare Earth Minerals

Investigations of some Insufficiently Studied Rare Earth Minerals from the Ilmen Mountains. By G. P. Barsanov. *Mém. Soc. Russe Minéral., 2ième Série*, 1944, **73**, Nos. 2-3, 101-109. [In Russian with English summary.]

Thorites from Pegmatite Vein of the Sludianka. By P. V. Kalinin. *Mém. Soc. Russe Minéral., 2ième Série*, 1945, **74**, No. 3, 200-204. [In Russian with English summary.]

Tantalum

World Survey of Tantalum Ore. By J. S. Baker. *Inform. Circ. No.*

7319, *U.S. Bur. Mines*. Pp. 48, 10½ × 8, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Tin

Sizing up To-day's Tin Picture and Prospects. Statement by the [American] War Production Board. *Foreign Comm. Wkly.*, 1945, **21**, No. 2, 9, 44.

Developments in Tin and Tin Alloy Coatings. By E. S. Hedges. *J. Soc. Chem. Ind., Lond.*, 1945, No. 47, 370-373.

Tin Deposits of the Republic of Mexico. By W. F. Foshag and C. Fries. Jun. *Bull. No.* 935-*C*, *U.S. Geol. Surv.* Pp. 78, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 40 cents.

The Tin-Spodumene Belt of the Carolinas. Preliminary Report. By T. L. Kesler. *Bull. No.* 936-*J*, *U.S. Geol. Surv.* Pp. 25, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 50 cents.

Tin Deposits of Irish Creek, Virginia. By A. H. Koschmann, J. J. Glass and J. S. Vhay. *Bull. No.* 936-*K*, *U.S. Geol. Surv.* Pp. 26, 5¾ × 9, and map. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 10 cents.

Tin and Tungsten Deposits at Silver Hill, Spokane County, Washington. By L. R. Page. *Bull. No.* 931-*H*, *U.S. Geol. Surv.* Pp. 27, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 30 cents.

The Tin Industry of East Asia. *Min. J.*, 1945, **225**, No. 5757, 886-888.

A Black Bipyramidal Cassiterite from the Kester Deposit in the Basin of the Yana River. By B. I. Vronsky and I. A. Ostrovsky. *Mém. Soc. Russe Minéral.*, *2ième Série*, 1945, **74**, No. 2, 137-143. [In Russian with English summary.]

Titanium

Extraction of Titanium Dioxide from Red Mud. By D. Swarup and A. S. Sharma. *Trans. Indian Ceram. Soc.*, 1945, **4**, No. 2, 75.

Tungsten

Tungsten Deposits of the Nightingale District, Pershing County, Nevada. By W. C. Smith and P. W. Guild. *Bull. No.* 936-*B*, *U.S. Geol. Surv.* Pp. 20, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 40 cents.

Tin and Tungsten Deposits at Silver Hill, Spokane County, Washington. By L. R. Page. *Bull. No.* 931-*H*, *U.S. Geol. Surv.* Pp. 27, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 30 cents.

The Chicote Tungsten Deposit, Bolivia. By F. Ahlfeld. *Econ Geol.*, 1945, **40**, No. 6, 394-407.

Uranium

Contribution to Method and Practice of a Rapid Microchemical Detection of Uranium in Minerals. By G. P. Barsanov. *Mém. Soc. Russe Minéral.*, *2ième Série*, 1945, **74**, No. 3, 232-235. [In Russian.]

Fluorescent Bead Test for Uranium in Minerals. By M. A. Northup. *Industr. Engng. Chem.* (*Anal. Ed.*), 1945, **17**, No. 10, 664-670, with references.

A Colorimetric Method for the Determination of Uranium in Leach Liquors. By T. R. Scott and P. Dixon. *Analyst*, 1945, **70**, No. 837, 462-465.

South-West Africa: Control of Uranium, Chemical Compounds and

Physical Combinations of which Uranium is a Constituent. *Official Gazette (Extraordinary) of South West Africa*, November 12, 1945, 7801.

Uranium in South Australia. *Chem. Engng. Min. Rev.*, 1945, **38**, No. 446, 47.

On the Uranovanadate from the Maili-su Deposit in Kirguizia. By V. G. Melkov. *Mém. Soc. Russe Minéral., 2ième Série*, 1945, **74**, No. 1, 41-47. [In Russian with English summary.]

Vanadium

On the Uranovanadate from the Maili-su Deposit in Kirguizia. By V. G. Melkov. *Mém. Soc. Russe Minéral., 2ième Série*, 1945, **74**, No. 1, 41-47. [In Russian with English summary.]

NON-METALS

Miscellaneous Non-Metallic Minerals

The Thermal Insulation of Structures. By J. S. F. Gard. *Fuel Econ. Rev.*, 1945, **24**, 37-44.

Some Standard Thermal Dehydration Curves of Minerals. By P. G. Nutting. *Prof. Pap. No.* 197-*E, U.S. Geol. Surv.* Pp. 21, $11\frac{1}{2} \times 9$. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1943.) Price 5 cents.

Asbestos

Sunnyside Asbestos Mining Company, Limited. By A. Stuart. *S. Afr. Min. Engng. J.*, 1945, **56**, Pt. 2, No. 2750, 203-207.

Barytes

The Concentration of Barite-Fluorite Ores from the Lake Ainslie District, Nova Scotia. By E. L. Cameron. *Canad. Min. Metall. Bull.*, 1945, No. 401, 567-585.

Building Materials

Gypsum and Anhydrite Building Plasters. *Brit. Stand. Instn. Specif.* 1191: 1944. *Amendment No.* 1: September, 1945. Pp. 22, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: British Standards Institution, 1945.) Price 2*s*.

Experiences in Grinding Raw Materials for Portland Cement. By C. D. Rugen. *A.I.M.E. Tech. Pub. No.* 1893, 12 pp. *Min. Tech.*, 1945, **9**, No. 6, with diagrams.

Calcite

Methods of Prospecting and Mining Optical Calcite in Montana. By E. W. Newman. *A.I.M.E. Tech. Pub. No.* 1896, 10 pp. *Min. Tech.*, 1945, **9**, No. 6, with photographs and map.

Chemical Products

Carbon Black in War and Peace. By L. H. Cohan. *Chem. Engng. News*, 1945, **23**, No. 22, 2078-2085, 2145, with extensive bibliography.

New Use for Plastics. By J. Delmonte. [Abstract.] *Chem. Tr. J.*, 1945, **117**, No. 3057, 21. [Impregnation of plaster of Paris with plastics.]

Important New Dielectrics. By G. S. Smith. *Chem. Age*, 1945, **53**, No. 1376, 429-431.

United Kingdom: S.R. and O. No. 1170. The Control of Sulphuric Acid (No. 2) Order, 1940, Direction No. 4. *Ministry of Supply.* Pp. 2, $9\frac{1}{2} \times 6$. (London: H.M. Stationery Office, 1945.) Price 1*d*.

China Clay

Winning China Clay in Cornwall. By W. O. Meade-King. *Min. J.*, 1945, **225**, No. 5756, 866-868.

Clay and Ceramics

Recent Developments in Grinding Ceramic Materials in Pebble, Ball, and Tube Mills. By G. F. Metz. *Bull. Amer. Ceram. Soc.*, 1945, **24**, No. 10, 357-361.

Adsorbent Clays; Their Distribution, Properties, Production, and Uses. By P. G. Nutting. *Bull. No.* 928-*C, U.S. Geol. Surv.* Pp. 95, 5¾ × 9. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1943.) Price 20 cents.

The Action of Some Aqueous Solutions on Clays of the Montmorillonite Group. By P. G. Nutting. *Prof. Pap. No.* 197-*F, U.S. Geol. Surv.* Pp. 17, 11½ × 9. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1943.) Price 10 cents.

The Use of Infra-red Drying in Pottery Manufacture. By S. W. Ratcliffe and H. W. Webb. *Trans. Brit. Ceram. Soc.*, 1945, **44**, No. 8, 119-133.

Scheme for a Central Ceramic Research Station. *Trans. Indian Ceram. Soc.*, 1945, **4**, No. 2 (Supplement). Pp. 48, 8½ × 5½. (Benares: Hindu University, Department of Ceramics.) Price to non-members Rs. 2.

Clays in India. By M. L. Misra. *Trans. Indian Ceram. Soc.*, 1945, **4**, No. 2, 41-74.

The Industrial Utilization of a Sand-Clay Mixture from Falls and Robertson Counties, Texas. *Rep. Invest. No.* 3825, *U.S. Bur. Mines.* Pp. 30, 10½ × 8, and figs. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Kaolinite Diaspore-bearing Agalmatolites in the Altai. By N. I. Nakovnik. *Mém. Soc. Russe Minéral., 2ième Série*, 1944, **73**, No. 1, 48-55. [In Russian with English summary.]

Coal, etc.

Charcoal Briquettes as a Coal Substitute. By H. Green and T. N. Jewitt. *J. Soc. Chem. Ind., Lond.*, 1945, **64**, No. 10, 265-271.

Applied Research in the Bituminous Coal Industry. By H. F. Hebley. *Canad. Min. Metall. Bull.*, 1945, No. 401, 539-559.

Determination of the Size Distribution of Fine Coal Particles by the Electron Microscope. By J. T. McCartney. *Rep. Invest. No.* 3827, *U.S. Bur. Mines.* Pp. 11, 10½ × 8, and figs. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Coal and Atmospheric Pollution. By A. Parker. *Fuel Econ. Rev.*, 1945, **24**, 82-86.

Coal in the Machine Age. By R. C. Smart. *Fuel Econ. Rev.*, 1945, **24**, 79-81.

Winning Coal at a Modern British Colliery. *Fuel Econ. Rev.*, 1945, **24**, 58-61.

Chemicals from Coal in the North. [Abstract from two reports to the Government made by the Coal Processing Industries Panel of the Northern Industrial Group.] *Chem. Age*, 1945, **53**, No. 1381, 565-568.

The Coking Coal Resources in the Yorkshire, Nottinghamshire and Derbyshire Coalfield. By R. A. Mott. *Trans. Instn. Min. Engrs., Lond.*, 1945, **104**, Pt. 9, 446-468.

Fife Coal Company's Undertaking. An Interesting Visit of Inspection. By E. Cope. *Iron Coal Tr. Rev.*, 1945, **151**, No. 4061, 1033-1035.

The Production of both Coking and Steam Coals from the Witbank Coalfield. By L. A. Bushell, S. B. Gass, F. W. Quass and R. F. J. Teichman. *J. Chem. Metall. Min. Soc. S. Afr.*, 1945, **46**, Nos. 1 and 2, 45-59.

The Coal Tar Distillation Industry [in Canada], 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 4, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1945.) Price 15 cents.

Calculation of the Calorific Value of Indian Coals from Proximate Analysis. By P. S. Mene and M. S. Viswanathan. *Quart. J. Geol. Min. Metall. Soc. India*, 1945, **17**, No. 2, 29-32.

Some Notes on American Coal-Mining Practice. By H. S. Haslam. *Iron Coal Tr. Rev.*, 1945, **151**, No. 4056, 797-801; No. 4057, 843-847.

Diamonds

The Diamond Industry in 1944: Twentieth Annual Review. By S. H. Ball. Pp. 24, 11½ × 8½. (New York: Jewelers' Circular—Keystone, 1945.)

Some Details of Diamond-Drilling Equipment. By S. V. Griffith. *Min. Mag., Lond.*, 1945, **73**, No. 6, 343-347.

Selection of Industrial Diamonds. By P. Grodzinski. *Min. J.*, 1946, **226**, No. 5759, 5-7.

Venezuela—The Guayana Highlands. Diamondiferous Alluvials of the State of Bolivar. By J. C. Davey. *Min. Mag., Lond.*, 1946, **74**, No. 1, 9-26.

Felspar

Scottish Sources of Alkali Feldspar. By T. Robertson. *Wartime Pamphlet No.* 44, *Geol. Surv. Great Britain.* Pp. 37, 12¾ × 8. (London: Geological Survey and Museum, 1945.) Price 1*s.* 9*d.*

The Feldspar and Quartz Mining Industry in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 9, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1945.) Price 25 cents.

Fluorspar

A Projected Central Mill for the Durham Fluorspar Industry. By A. Pearson. *Bull. Instn. Min. Metall., Lond.*, 1946, No. 476, 19 pp.

The Concentration of Barite-Fluorite Ores from the Lake Ainslie District, Nova Scotia. By E. L. Cameron. *Canad. Min. Metall. Bull.*, 1945, No. 401, 567-585.

Geological and Geophysical Survey of Fluorspar Areas in Hardin County, Illinois. Part 1. Geology of the Cave in Rock District. By L. W. Currier and O. E. Wagner, Jun. Part 2. An Exploratory Study of Faults in the Cave in Rock and Rossiclare Districts by the Earth-Resistivity Method. By M. King Hubbert. *Bull. No.* 942, *U.S. Geol. Surv.* Pp. 150, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1944.) Price $1.25.

Gemstones

The Science of Gemmology—III. By E. Gübelin. *J. Gem.*, 1945, October, 559-561. The colour-grading of diamonds and the testing of pearls.

The Ruby—Gem of the East. Some Notes on the History, Occurrence and Mining of the Ruby. By D. C. McLaren. *Canad. Min. J.*, 1945, **66**, No. 12, 852-854.

Re Agate—Agate Creek, Percyville. By J. E. Ridgway. *Queensland Govt. Min. J.*, 1945, **46**, No. 528, 299-301.

Glass

Glass Sand and a Glass Industry in Puerto Rico. By H. A. Meyerhoff and J. E. Frazier. *A.I.M.E. Tech. Pub. No.* 1939, 9 pp. *Min. Tech.*, 1945, **9**, No. 6, with tables and maps.

Graphite

Black Donald Graphite. Canada's Most Important Graphite Deposit. By D. C. McLaren. *Canad. Min. J.*, 1945, **66**, No. 11, 763-772.

Graphite Deposits of Patna State, Orissa. By T. P. Misra. *Quart. J. Geol. Min. Metall. Soc. India*, 1945, **17**, No. 2, 33-43.

Lime and Limestone

Tufa Lime Manufacture at Umaria, C.I. By M. C. Basu Roy Chowdhury. *Quart. J. Geol. Min. Metall. Soc. India*, 1945, **17**, No. 2, 45-51.

Mica

The Mica Mining Industry in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 8, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1945.) Price 25 cents.

Western Australia: Mica. By R. S. Matheson. *Bull. No. 2, Dep. Mines W. Austr.* Pp. 70, 5½ × 8½, and maps. (Perth: Government Printer, 1944.)

Structural and Economic Characteristics of New England Mica Deposits. By E. N. Cameron, D. M. Larrabee, A. H. McNair, J. J. Page, V. E. Shainin and G. W. Stewart. *Econ. Geol.*, 1945, **40**, No. 6, 369-393.

Muscovite in the Spruce Pine District, North Carolina. By T. L. Kesler and J. C. Olson. *Bull. No. 936-A, U.S. Geol. Surv.* Pp. 38, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 35 cents.

Mineral Waters

On the Chloride Waters of Great Britain. By W. Anderson. *Geol. Mag., Lond.*, 1945, **82**, No. 6, 267-273.

Petroleum, etc.

Petroleum at War. Pp. 35, 13 × 11. (London: "The Petroleum Times"). Price 4s. Reprinted from *Petrol. Times*, Sept., 29, Oct., 13, 27, and Nov., 10, 24, 1945.

The UOP MS-Type Catalytic Cracking Unit; Meeting the Needs of the Smaller Refiner. By N. K. Anderson and M. J. Sterba. *Petrol. Times*, 1945, **49**, No. 1263, 1080-1082.

Fluid Catalytic Cracking. By H. Dimmig. *Petrol. Times*, 1945, **49**, No. 1262, 1036-1038.

Oil Migration. By J. Frost. *J. Inst. Petrol.*, 1945, **31**, No. 264, 486-493.

D'Arcy Oil Search in Britain. *Petrol. Times*, 1945, **49**, No. 1262, 1015-1016, 1051.

Petroleum in Great Britain. By A. Bray. *Mine and Quarry Engng.*, 1945, **10**, No. 12, 297-300.

Asphaltic Road Oils from Alberta Bituminous Sands. By K. A. Clark. *Canad. Chem. Proc. Industr.*, 1945, **29**, No. 9, 616-617.

Attock Oil Co.'s Discovery at Joya Mair. *Petrol. Times*, 1945, **49**, No. 1262, 1028, 1030.

Notes on the Geology of the Southern Rumanian Oil District with Special Reference to the Occurrence of a Sedimentary Laccolith. By J. F. M. de Raaf. *Quart. J. Geol. Soc. Lond.*, 1945, **101**, Pts. 1 and 2, 111-134, with plates and map.

Method of Handling Hydrogen Sulphide Gas in the Elk Basin Oil Field of Wyoming. By J. H. East, Jun., and R. H. Espach. *Inform. Circ., No. 7334, U.S. Bur. Mines.* Pp. 7, 10½ × 8, and photographs. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Phosphates

Phosphate Resources of Florida. By G. R. Mansfield. *Bull. No.* 934,

U.S. Geol. Surv. Pp. 82, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price $1.

Phosphate Deposits of the Teton Basin Area, Idaho and Wyoming. By L. S. Gardner. *Bull. No.* 944-*A*, *U.S. Geol. Surv.* Pp. 36, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1944.)

Quartz

Quartz Crystal as a Mineral Resource. By R. B. McCormick. *A.I.M.E. Tech. Pub. No.* 1916, 4 pp. *Min. Tech.*, 1945, **9**, No. 6.

The Feldspar and Quartz Mining Industry in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 9, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1945.) Price 25 cents.

Refractories

Refractory Magnesia (Magnesite). *Rep. No.* 12, *War Changes in Industry Series, U.S. Tariff Commission.* Pp. 55, 9 × 5¾. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 15 cents.

Dolomite Linings for Basic Electric Arc Furnaces. Abstract of a Paper submitted to the Iron and Steel Institute by E. C. Brampton, H. Parnam and J. White. *Iron Coal Tr. Rev.*, 1945, **151**, No. 4058, 891-896, with diagrams.

Topaz Deposits near the Brewer Mine, Chesterfield County, South Carolina. By C. Fries, Jun. *Bull. No.* 936-*C*, *U.S. Geol. Surv.* Pp. 20, 5¾ × 9, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 30 cents.

Salt

Salt: Modern Aspects of an Age-old Industry. By E. R. Varley. *Crown Colon.*, 1945, **15**, No. 169, 835-836.

Salinas do Rio Grande do Norte. By F. T. Siqueira. *Bol. Secretar. Agric. Industr. Comer., Pernambuco*, 1941, **7**, No. 2, 143-156, with photographs. [In Spanish.]

Sulphur

The San Telmo Ore Body, Spain. By J. C. Allan. *Bull. Instn. Min. Metall., Lond.*, 1946, No. 476, 15 pp.

Sulphur Production in Central Asia. By M. Makarov. *Chem. Tr. J.*, 1945, **117**, No. 3050, 489.

Water Power and Supply

Drinking Water from Sea Water. *Chem. Age*, 1945, **53**, No. 1376, 437-439.

Stream-Gaging Procedure. By D. N. Corbett and others. *Water-Supply Pap. No.* 888, *U.S. Geol. Surv.* Pp. 245, 5¾ × 9. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 75 cents.

Hydro-Electric Power Resources of the World. By E. G. Saunders. *Fuel Econ. Rev.*, 1945, **24**, 14-22.

Treatment of Mine Water for Domestic Use. By R. Walmsley and W. E. Jones. *A.I.M.E. Tech. Pub. No.* 1913, 12 pp. *Min. Tech.*, 1945, **9**, No. 6, with photographs and tables.

Small Reservoirs in Uganda. By C. B. Bisset. *Water-Supply Pap. No.* 2, *Uganda Geol. Surv.* Pp. 44, 9¾ × 6. (Entebbe: Government Printer, 1945.)

Geological Features of Artesian Water Basin [Australia]. *Chem. Engng. Min. Rev.*, 1945, **38**, No. 445, 3-6.

Conditions of Underground Water in the Western Emek (Plain of

Esdraelon). By L. Picard. *Bull. Geol. Dep., Hebr. Univ., Jerusalem*, 1936, **1**, No. 1. Pp. 24. Also two maps and version in Hebrew.

Groundwater in Palestine. By L. Picard. *Bull. Geol. Dep., Hebr. Univ., Jerusalem*, 1940, **3**, No. 1. Pp. 24.

Zircon

Zircon. By K. R. Krishna Iyer. *Trans. Indian Ceram. Soc.*, 1945, **4**, No. 2, 81-88.

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PLANT AND ANIMAL PRODUCTS

ARTICLE

THE PAPER-MAKING PROPERTIES OF YAWA FIBRE

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Source and Availability

YAWA fibre is derived from the flowering stem of a leguminous plant, *Vigna sinensis* var. *textilis*, a variety of the common cow-pea. The plant is cultivated in Nigeria, principally in the Niger Province, where the fibre obtained from it is employed by the natives for making into ropes, twines and, more particularly, fishing nets. The fibre is reputed to have good water-resistance. The plant bears long pods containing beans which, although edible, are said to be less popular than the seeds of the ordinary cow-pea.

The preparation of Yawa fibre is simple but laborious. Retting is not resorted to, the fibre being obtained by hand-stripping, a process which is facilitated by the fact that the fibre strands are located on the outside of the stalk. The process involved is briefly as follows:

After the crop has ripened and the beans have been gathered, the dry stalks are cut and allowed to dry for a further period. The fibre is then separated by crushing each stem between the finger and thumb and peeling off the fibre in strips. The strips are spread out for a final short drying period before being made up into bundles for use.

The resulting Yawa fibre is in the form of pale straw-coloured ribbons up to about ¼ in. in width and up to 3 ft. in length. It is clean, free from extraneous material and superficially somewhat resembles raffia in appearance.

War-time interest in Yawa fibre

Interest in the paper-making properties of Yawa fibre first arose in the summer of 1941 when the Agricultural Department, Nigeria, wrote to the Imperial Institute enquiring whether any information was on record as to the suitability of this fibre for the

manufacture of paper. The Nigeria Agricultural Department mentioned that a quantity of Yawa fibre was available, and added that it was believed that materially increased tonnages could be obtained if a demand for the material were to arise.

No information could be traced in the literature regarding the paper-making properties of Yawa fibre. However, from such preliminary work as it was possible to undertake in the Imperial Institute Laboratories on the 12 oz. sample of fibre which had accompanied the enquiry from Nigeria, it was found that the material had promising paper-making characteristics. With such a limited quantity of fibre available, it was only possible to carry out a single soda cook, but this trial was sufficient to show that Yawa fibre gives a fairly high yield of long-fibred pulp possessing outstandingly good strength characteristics.

As a result of this preliminary investigation, the Imperial Institute suggested that sufficient fibre should be despatched from Nigeria to enable a more complete investigation to be conducted into its paper-making possibilities. In response to this suggestion, a consignment of 1 cwt. of Yawa fibre reached the United Kingdom during the spring of 1942. By this time the scientific staff of the Imperial Institute had been severely depleted by the secondment of officers for war duties elsewhere, and the Institute was temporarily unable to undertake paper-making investigations. However, the Ministry of Supply (Controller of Chemical Research and Development) was becoming increasingly interested in the possibilities of new long-fibred paper-making materials, as the supply of raw materials for the manufacture of certain important speciality papers was beginning to give rise to anxiety.

Following discussion between the two Departments, it was agreed that arrangements should be made for a portion of the fibre then available to be consigned for examination and report to a paper mill, specialising in the manufacture of long fibred tissues, whilst the remainder would be forwarded to Messrs. Cross & Bevan, with whom the Ministry of Supply would arrange an Extra-mural Research Contract for the investigation of the paper-making properties of Yawa fibre, with special reference to its value as an alternative to Manila hemp.

As a result of these investigations, which are fully reported later in this article, it was felt by the Ministry of Supply that mill trials would be justified as an insurance against a further deterioration in the supply position. Arrangements were accordingly made for the importation of ten tons of Yawa fibre and for trials at three mills specialising in the manufacture of different types of paper for the production of all of which, in normal times, Manila hemp is employed. As will be seen from the reports quoted later, all three mills were, in varying degrees, favourable to the use of Yawa fibre.

Unfortunately, the price at which Yawa fibre could be made available to paper makers in this country was excessively high.

Moreover, enquiries in Nigeria elicited the fact that the quantity of fibre immediately available for shipment to the United Kingdom was, in terms of tonnages in which raw materials are consumed in the paper industry, not very large. In view of the fact that Yawa fibre is derived from a cultivated plant, it would be possible to increase production substantially within a short period by taking steps to conserve seed and by encouraging planting. Delays in securing any important quantity of fibre would, however, be inevitable. The policy of the Nigerian Department of Agriculture, at this period of the war, was to concentrate on the production of palm kernels, rubber, and ground nuts, and it was apparent that it would not be possible to justify a request for special measures to be taken to increase the production of Yawa fibre, unless that fibre proved to be essential for the manufacture of papers with high priority applications.

Meanwhile, however, experiments which were being conducted on the substitution of Manila with other cheaper and more freely available raw materials were meeting with reasonable success. It was, therefore, decided that it would not be possible to justify either the purchase of the available tonnage of Yawa fibre or the sponsoring of the increased cultivation of that material in Nigeria.

Nevertheless, as the investigations here reported will make clear, Yawa fibre is technically of undoubted value for paper-making purposes. The long-fibred materials with which it would have to compete commercially are, however, relatively cheap, being available in the form of various industrial wastes, for example, cuttings, tows, old ropes, etc. Whether, therefore, any developments will prove possible in the utilisation of Yawa fibre for paper-making will depend entirely on the prospects of its being offered to the paper industry at an economic price. This, in turn, may depend on whether some more rapid method of fibre separation can be evolved. This is a question which may well repay serious attention.

Laboratory Investigations

General Analysis

A representative sample of Yawa fibre with an air-dry moisture content of 9.9 per cent. gave on analysis the results set out in Table I.

TABLE I

Composition.	*Per cent. on moisture-free material.*
Cellulose (by chlorination)	59·1
Pentosan (calculated from furfural content)	6·63
Acetone-Soluble Material	2·44
Ash, total	4·90
containing :	
Silica (as SiO_2)	0·20
Iron and Aluminium (as Al_2O_3, Fe_2O_3)	0·33
Manganese (as MnO)	0·036
Calcium (as CaO)	0·84
Magnesium (as MgO)	0·76

Examination of the cellulose obtained in the above estimation provided the following figures:

	On moisture-free cellulose per cent.
Pentosan in Cellulose (calculated from furfural content)	4·40
Ash in Cellulose	0·41

From the foregoing figures it will be seen that the cellulose content of the material, although higher than that of most woods, cereal straws and similar raw materials, is rather lower than that of Manila and the textile wastes normally employed for the production of long-fibred pulps. The pentosan and resin content are both low but the ash figure is rather high.

Characteristics of the Ultimate Fibres

Ultimate fibres were isolated from the material and examined microscopically, when they were seen as very long fibres with well defined lumens and tapering ends. Their most strongly marked characteristic was the presence of short longitudinal striations, probably fissures on the surface of the fibres. There were also present rather wider thin-walled fibres which had collapsed into the form of twisted ribbons.

TABLE II

Laboratory soda cooks to determine the effect of variations in caustic soda concentration and cooking temperature at a constant cooking time of 4 hours (at maximum temperature) and a standard ratio of cooking liquor to air-dry raw material of 7 to 1.

Cook Number.	Maximum Temperature.	Parts of Caustic Soda used per 100 parts of Moisture-free Material.	Parts of Caustic Soda Consumed per 100 parts of Moisture-free Material.	Sieber Chlorine Number.	Permanganate Number.	C.A. Viscosity, ½ per cent. Cellulose.	Yield of Moisture-free Pulp on Moisture-free Raw Material.
	° C.					Cps.	per cent.
1Y	160	11·1	11·1	2·00	37·8	26·1	60·3
2Y	160	22·2	20·3	1·30	18·6	15·0	59·6
3Y	160	33·3	24·6	1·01	15·7	7·4	58·4
4Y	140	11·1	11·1	2·17	37·9	33·9	65·3
5Y	140	22·2	19·3	1·60	26·4	25·0	63·2
6Y	140	33·3	20·2	1·32	23·4	19·2	61·6
7Y	120	11·1	11·1	2·70	42·6	39·8	66·1
8Y	120	22·2	16·5	2·06	30·4	27·0	64·3
9Y	120	33·3	18·6	1·39	28·7	26·0	62·0

TABLE III

Laboratory soda cooks to determine the effect of variations in cooking time using a maximum temperature of 160° C. and caustic soda concentrations of 20 and 30 per cent. on the weight of air-dry raw material.

Cook Number.	Time at Maximum Temperature.	Parts of Caustic Soda used per 100 parts of Moisture-free Material.	Parts of Caustic Soda Consumed per 100 parts of Moisture-free Material.	Sieber Chlorine Number.	Permanganate Number.	C.A. Viscosity, ½ per cent. Cellulose.	Yield of Moisture-free Pulp on Moisture-free Raw Material.
	hours.					*Cps.*	*per cent.*
2Y	4	22·2	20·3	1·30	18·6	15·0	59·6
10Y	5	22·2	20·8	1·29	17·8	11·0	59·4
11Y	6	22·2	21·5	1·05	17·0	8·5	59·6
3Y	4	33·3	24·6	1·01	15·7	7·4	58·4
12Y	5	33·3	23·6	0·91	15·8	5·8	54·7
13Y	6	33·3	24·8	0·81	13·3	5·7	52·4

The dimensions of the ultimate fibres were as follows:

	Minimum. mm.	*Maximum.* mm.	*Average.* mm.
Length . . .	1·1	8·7	4
Width . . .	0·011	0·066	0·030

Ratio of average length to average width, 133 : 1.

It will be noted that the ultimate fibres of Yawa fibre, although long compared with the majority of paper-making fibres, are only of the order of 60 per cent. of the length of the ultimates of Manila hemp.

Laboratory Pulping Trials

Experimental soda cooks were carried out using a small, stationary, gas-heated laboratory digester. The trials covered a range of temperatures and caustic soda concentrations, in all of which the ratio of liquor to air-dry raw material was standardised at 7 to 1.

In Table II are shown the results of nine cooks, viz. 1Y to 9Y, carried out at a fixed cooking time of 4 hours and at temperatures of 120° C., 140° C., and 160° C., and caustic soda concentrations of 11·1, 22·2 and 33·3 per cent. respectively. These figures show that the relatively high temperature of 160° C. employed in cooks 1Y to 3Y has not caused either excessive degradation of the pulp or serious reduction in the yield. Moreover, the degree of resolution of these pulps was such as to favour the development of strength.

Pulp Evaluation Results

The strength characteristics of the pulps produced during the course of the experiments were evaluated by the P.M.A. Standard Sheet method, with certain modifications necessitated by the characteristics of the pulps; bleachability was evaluated by the determination of Sieber Chlorine Number and Permanganate Number; and the degree of degradation of the cellulose was assessed by the measurement of cuprammonium viscosity. In order to enable such long-fibred stuff to be satisfactorily beaten in the Lampén mill it was given three times the specified time in the Standard disintegrator. A further modification was imposed by the fact that the tearing strength of some of the Standard Sheets exceeded the range of the Marx-Elmendorf tearing tester. The determination of the tearing strength of such papers as could be torn in the form of single sheets on the Marx-Elmendorf instrument was carried out in the usual way. These papers were also tested by pulling a single tear in the Schopper tensile strength tester. The results from thirty samples tested in this way were plotted, setting the ratio between Schopper and Marx-Elmendorf values against Schopper results. Good correlation along a straight line was obtained. The papers which were too strong for the Marx-Elmendorf tester were, therefore, tested on the Schopper machine and by means of the curve all determinations were converted into a comparable basis, the results being expressed as tear factors calculated in accordance with the recommendations of the Second Report of the Pulp Evaluation Committee.

Whilst it is generally preferred to compare the properties of pulps at a standard freeness or beating degree and, whilst it is clear that a fibre of this type would be unlikely to be used in the unbeaten condition, it is, nevertheless, instructive to compare the properties of the unbeaten pulps as set out in Table IV. In the first series of nine cooks at a fixed cooking time, the highest tearing strength was shown by pulps 2Y and 3Y. This fact, combined with the good folding strength of these pulps, confirmed the conclusion reached on the results shown in Table II, indicating that the relatively high cooking temperature of 160° C. should be used in further trials with varying cooking times and caustic soda concentrations.

On beating, it was found that the freeness values of the pulps from the various cooks extended over such a wide range that it was considered more satisfactory to compare the properties of the beaten pulps after a standard beating time rather than, as is usually preferred, to compare interpolated figures for some fixed degree of freeness.

It was accordingly decided to compare the figures for pulps after disintegrating for 75,000 revolutions and beating for 30 minutes at 3 per cent. consistency in a Lampén mill. The results obtained are shown in Table V.

Table IV

Pulp evaluation figures for unbleached and unbeaten pulps from Yawa fibre.

Cook Number.	1Y	2Y	3Y	4Y	5Y	6Y	7Y	8Y	9Y	10Y	11Y	12Y	13Y
Canadian Freeness, degrees	485	497	333	550	504	470	658	560	537	455	476	544	538
Apparent Specific Gravity	0·469	0·490	0·535	0·439	0·450	0·473	0·464	0·494	0·428	0·528	0·472	0·429	0·459
Breaking Length, metres	5,060	4,610	4,950	4,560	4,690	5,980	4,440	4,330	4,900	4,710	4,970	4,610	4,240
Burst Factor	53·9	50·7	50·0	48·2	57·1	73·3	53·3	61·4	50·2	49·1	56·5	53·1	44·5
Tear Factor	317	435	374	338	333	350	317	327	315	439	478	440	263
Folding Endurance, M.I.T., double folds	2,034	2,572	2,102	1,983	2,383	2,325	2,374	2,907	1,572	1,744	3,594	1,267	990
Stretch, per cent.	3·8	4·6	6·4	3·4	3·5	4·8	4·3	4·3	4·3	4·8	6·3	4·4	3·9

Table V

Pulp evaluation figures for unbleached pulps from Yawa fibre after beating for 30 minutes in the Lampén ball mill at 3 per cent. consistency.

Cook Number.	1Y	2Y	3Y	4Y	5Y	6Y	7Y	8Y	9Y	10Y	11Y	12Y	13Y
Canadian Freeness, degrees	439	390	234	444	420	387	446	368	328	371	253	512	416
Apparent Specific Gravity	0·532	0·530	0·592	0·524	0·545	0·508	0·562	0·556	0·512	0·533	0·469	0·471	0·558
Breaking Length, metres	5,120	5,670	5,940	5,400	6,010	7,010	4,940	5,350	5,920	5,110	4,920	5,710	5,610
Burst Factor	62·3	65·6	69·0	66·4	62·6	70·8	65·0	63·6	63·9	57·2	46·2	54·0	47·5
Tear Factor	330	402	382	328	320	350	312	325	305	371	420	367	246
Folding Endurance, M.I.T., double folds	2,537	3,828	2,401	2,760	2,726	4,762	3,084	3,846	2,147	2,259	3,319	1,737	439
Stretch, per cent.	4·5	6·1	6·7	4·6	4·4	4·9	4·4	4·5	4·5	7·0	5·3	4·8	4·0

The trends apparent in the properties of the unbeaten pulps were confirmed after beating. The pulp from Cook 2Y showed the best all-round strength, possessing particularly high tearing and folding strength features which may be regarded as essential requirements in a Manila type paper. Pulp 11Y, which, in the unbeaten state, was in every respect stronger than 2Y, and was, in fact, the best of the unbeaten pulps, failed to maintain its superiority after beating, a fact which can no doubt be taken as an indication that the increased cooking time which 11Y had received had resulted in over-cooking. The lower viscosity of 11Y (see Table II) supported this view.

Comparison with Manila Pulps

The foregoing experimental work having established the approximate conditions necessary with the particular laboratory equipment used, for the pulping of Yawa fibre, it was considered to be of interest to make some direct comparisons by pulping Manila fibre by the same technique.

For this purpose, a batch of raw Manila fibre was employed which, it should perhaps be mentioned, originated from British North Borneo and not from the Philippines, the normal commercial source of Manila. It was, however, genuine *Musa textilis* fibre and was in no way abnormal. Experimental cooks were carried out under the conditions which had been employed for boiling Yawa fibre in cooks 2Y and 11Y. The results obtained are shown in Table VI, which also includes, for convenience in comparison, the corresponding figures for Yawa fibre.

It will be noted that when the two materials are cooked under identical conditions, the yield from Manila fibre is substantially higher than that obtained from Yawa, whilst at the same time Manila pulps, as shown by their bleachability figures, are more fully resolved. The Manila pulps are, in fact, to be regarded as being somewhat over-cooked, an indication that Manila fibre can be most satisfactorily pulped by employing rather milder conditions of digestion than are necessary for Yawa fibre.

Pulp evaluation figures for laboratory cooked Manila pulps B.M.1 and B.M.2 are set out in Table VII, in comparison with the corresponding figures for Yawa fibre, cook 2Y. This table also includes figures for a commercially produced Manila pulp B.

From a comparison between pulps produced under identical cooking conditions, i.e. B.M.1 and 2Y, it will be seen that pulps of the same order of bursting and tearing strength are obtained, but that Manila pulp has the advantage of superior tensile strength, whilst Yawa fibre gives higher folding strength values. As already mentioned, however, the Manila pulps had been too severely cooked and it will be observed that pulp B.M.2 has been over-cooked and degraded to such an extent that it shows serious loss of strength on beating. Even the cooking conditions employed in the production

TABLE VI

Comparative laboratory soda cooks on Yawa fibre and Manila fibre.

Raw Material.	Cook Number.	Maximum Temperature.	Time at Maximum Temperature	Parts of Caustic Soda used per 100 parts of Moisture-free Material.	Parts of Caustic Soda Consumed per 100 parts of Moisture-free Material.	Sieber Chlorine Number.	Permanganate Number.	C.A. Viscosity, ½ per cent. Cellulose.	Yield of Moisture-free Pulp on Moisture-free Raw Material.
		° C.	*hours.*					*Cps.*	*per cent.*
Manila . .	B.M.1	160	4	22·2	20·5	1·07	18·2	14·7	70·0
Yawa . .	2Y	160	4	22·2	20·3	1·30	18·6	15·0	59·6
Manila . .	B.M.2	160	6	33·3	23·8	0·73	9·1	5·6	65·9
Yawa . .	13Y	160	6	33·3	24·8	0·81	13·3	5·7	52·4

of B.M.1 were undoubtedly somewhat too severe. There is reason, therefore, to suppose that, by digestion under milder conditions, Manila pulps of higher strength values than that of B.M.1 could have been produced, but the investigation was not extended to the determination of the optimum laboratory conditions for the pulping of raw Manila as it was preferred to examine the strength of commercial Manila pulps.

Samples of commercial pulps were obtained from three mills. Their strength characteristics were found to vary widely, one industrial sample showing strength figures which fell below the values obtained in the laboratory cooks. Sample B, however, considerably exceeded the values obtained both for Yawa and for laboratory cooked Manila fibre except as regards its tearing strength where Yawa fibre was superior. The high strength of pulp B can be gauged from the fact that in tensile strength it is equal to a high grade Scandinavian bleached kraft wood pulp, whilst showing a 30 per cent. higher bursting strength and a 300 per cent. increase in tearing and folding resistance—levels which could not be reached with most other paper-making raw materials.

A single stage, alkaline hypochlorite bleaching trial was carried out using Yawa pulp 2Y and the pulp evaluation figures for the bleached material are also shown in Table VII. It will be observed that the bleaching treatment used caused considerable loss of folding resistance and some reduction in tearing strength, but that the bursting strength was maintained and the tensile strength improved.

At this stage in the investigation it was decided that sufficient data had been obtained adequately to establish that Yawa fibre was a promising Manila substitute and to provide the mills

undertaking full-scale trials with sufficient information to serve as a preliminary guide in the handling of this new material.

TABLE VII

Pulp evaluation figures for laboratory-pulped Yawa fibre (bleached and unbleached), laboratory-pulped Manila fibre and a commercial wet Manila pulp.

Pulp.	Beating Time.	Canadian Freeness.	Apparent Specific Gravity.	Breaking Length.	Burst Factor.	Tear Factor.	Folding Endurance, M.I.T.	Stretch.
	mins.	*degrees.*		*metres.*			*dble. folds*	*per cent.*
Yawa Fibre. Cook 2Y Unbleached Pulp.	0	503	0·481	4,510	50·3	440	2,459	4·8
	15	438	0·521	4,650	56·7	413	4,647	6·5
	30	402	0·526	5,610	64·2	389	3,432	5·9
	60	295	0·592	5,810	72·2	404	4,179	5·7
Yawa Fibre. Cook 2Y Bleached Pulp.	0	513	0·470	5,630	86·5	438	1,660	3·3
	15	500	0·521	5,350	57·2	362	1,155	3·5
	30	474	0·558	8,450	65·5	323	1,903	3·8
	60	385	0·564	7,490	71·1	238	2,061	4·3
Manila. Cook B.M.1 Unbleached Pulp.	0	698	0·482	7,680	55·0	404	1,591	3·2
	15	650	0·576	7,760	58·8	382	2,410	3·1
	30	556	0·678	7,800	65·9	251	3,251	3·3
	60	320	0·748	8,840	66·5	190	2,044	3·9
Manila. Cook B.M.2 Unbleached Pulp.	0	667	0·432	6,870	51·5	283	1,439	4·6
	15	648	0·565	6,770	50·2	217	486	4·4
	30	592	0·622	6,080	41·2	136	53	3·8
	60	481	0·660	4,900	30·9	121	18	4·1
Commercial Bleached Wet Manila. Pulp B. (Sieber Chlorine) Number=0·34. Permanganate Number=12·8.	0	623	0·581	9,860	80·9	298	6,483	5·1
	15	530	0·668	10,190	86·4	298	4,113	5·3
	30	520	0·700	10,640	100·0	292	4,367	5·8
	60	324	0·757	10,570	95·6	284	4,739	5·6

MILL TRIALS

The co-operation of three different paper mills, each of which normally employs Manila fibre for certain of its productions, was secured for the purpose of carrying out large-scale trials. The reports provided by these three firms are summarised below.

Mill A

At this mill Yawa fibre was cooked in a spherical boiler for 6 hours at 150° C., using 18 per cent. of caustic soda on the air-dried weight of fibre. A yield of about 54 per cent. expressed as

moisture-free pulp on moisture-free fibre was obtained. The resulting pulp was used to replace Manila as one component of the furnish of a special grade of high strength paper. Two types of paper were produced; in the first, half of the Manila content was substituted by Yawa fibre and in the other the Manila was wholly replaced by Yawa. Mill figures for tests on these two papers are given below in comparison with the corresponding figures for the Mill's standard grade.

	Substance. *Demy Wt.* lb.	Breaking length. *M.D.* *metres.*	*C.D.* *metres.*	Tear × 6 / Demy Wt. *M.D.*	*C.D.*	Burst. / Demy Wt.
Standard (Manila) . .	28½	8,600	4,850	11·3	12·2	2·55
Half Manila content replaced with Yawa .	28½	8,600	4,850	12·9	14·9	2·70
All Manila replaced by Yawa	27½	9,500	5,500	13·9	15·8	2·76

It will be noted that, by means of Yawa fibre, it has been possible to produce paper slightly exceeding the strength of the standard grade. This is no doubt to be attributed to the fact that the Manila fibre normally employed for this production is derived from old ropes, in which form the intrinsic strength of the original fibre may have deteriorated to some degree.

In reporting on these trials the Mill stated: "We are convinced that Yawa fibre would prove a very useful paper-making material and that it could in many cases be used in place of Manila."

Mill B

This firm specialises in the manufacture of tissues, for some of which very critical requirements have to be met. In the first place, therefore, Yawa fibre was tried out for the production of a special tissue which was proving very difficult to manufacture from any material other than new Manila. For this grade of paper it was found that the boiling of the Yawa fibre at high pressures gave most satisfactory results and cooked under the following conditions produced sheets satisfactorily free from shive.

5 hours at 70 lb. pressure with 30 per cent. caustic soda, (Viscosity of resulting pulp 5·2).

5 hours at 110 lb. pressure with 22·5 per cent. caustic soda (Viscosity of resulting pulp 3·7).

In each digestion, the final yield of washed and screened, unbleached pulp amounted to 44 per cent.

For this particular paper, for which evenness of formation was very important, Yawa fibre was not considered an ideal Manila substitute owing to a tendency for the Yawa ultimates to aggregate into bundles. On the other hand, its strength, although inferior to that of Manila, was reported to be better than that of any other substitute material investigated at the mill.

For other grades of tissues it was stated that very good results were obtained by low pressure boiling, followed by mild bleaching.

The firm concluded their report by writing: "If this fibre is obtainable we can make use of it."

Mill C

The trials at this mill were directed to the production of bleached papers from 100 per cent. Yawa fibre in a range of substances for comparison with high strength papers from Manila, in the production of which this firm specialises.

Yawa fibre was cooked for 8 hours with 28 per cent. caustic soda at 40 lb. pressure to give a yield of 44 per cent., accounted for as bleached paper and broke. A sample of pulp taken after bleaching and beating to S.R. 54° gave the following figures, which will be seen to be strikingly similar to those for pulp Y2 produced during the laboratory investigation:

Apparent specific gravity	0.556
Burst factor	66·8
Tear factor	356
Breaking length, metres	6110
Stretch, per cent.	7·2
Folding endurance, M.I.T., double folds	4287
Canadian freeness, degrees	200
Drainage time, seconds	15

Heavier beating of this pulp was not effective in improving strength properties, whilst the pulp was made considerably "wetter." It was considered that the beating tackle available at this mill was not ideal for handling Yawa pulps, sharper blades on the rolls being thought desirable. It was also suggested that slightly more severe cooking would be found an advantage in rendering the pulp more easily bleachable.

The papers produced during the trial were comparable in strength with pre-war grades made from Manila and, in the lightest substances, the Yawa papers were decidedly superior to pre-war, genuine 100 per cent. Manilas in tearing strength. In summarising their conclusions the mill commented as follows: "The fibre appears to be of excellent quality . . . compared very favourably with Manila hemp."

Conclusions

Laboratory investigations have established that paper approaching Manila standards for tear and folding strengths can be prepared from Yawa fibre. Slightly more severe cooking conditions are necessary than for Manila and the yield of pulp is lower. Mill-scale trials at three paper mills have confirmed the conclusions reached in the laboratory that, with minor adjustments in cooking, bleaching and beating treatment, it is possible for Yawa fibre to replace Manila in the production of many grades of paper.

Whether a use will be found for Yawa fibre in the paper industry in this country must depend upon whether it will ultimately prove possible to organise its cultivation and production in such a manner as to make it available at a price which can compete with other sources of long-fibred pulps.

Acknowledgment.

The authors wish to acknowledge their indebtedness to the Director of the Imperial Institute for information from the Institute's records and to the Ministry of Supply (Director-General of Scientific Research (Defence)) for permission to publish the results of work carried out under an Extra-mural Research Contract from that Department.

NOTES

Cashew Nuts.—The subject of cashew nuts has been dealt with previously in this BULLETIN (1916, **14**, 115; 1938, **36**, 44), but in view of the interest that has recently been shown in these nuts the following information is given.

The cashew nut tree (*Anacardium occidentale*) is a small evergreen tree 20 to 40 feet high. Along the coast where the soil is poor and the position exposed it is of low, spreading habit with crooked branches and often an irregular crown, but on sandy soil in a sheltered situation it grows more erect. The leaves are obovate, 12 to 18 inches in length and 6 to 8 inches wide. In season the tree bears clusters of small yellowish green flowers. The fruit is very unusual; it consists of the swollen receptacle which is known as the cashew " apple," and the true fruit, which is kidney shaped, is attached to the underside of the " apple "—the true fruit is known as the nut and contains the kernel. The " apple " is rather fibrous and juicy and makes up about 94 per cent. of the fruit.

The tree originated in tropical America and from there was introduced into India, Africa, West Indies, etc. It now grows wild along the East and West coasts of Southern India as far north as Bombay on the west and Vizagapatam on the east. It also grows wild in parts of East Africa, Tanganyika, Kenya and Uganda and especially Portuguese East Africa. The tree is semi-wild in the Gold Coast and is cultivated to some extent in Nigeria. Other countries where it is grown to-day are: Central America, the United States (Florida), Mexico, Brazil, Madagascar, Malay Peninsula, Peru, Hawaii, Tahiti, Ceylon, Philippine Islands, etc.

Cashew nut trees can be grown successfully on almost any soil, even on soils which are unsuitable for most other crops and in areas near the coast where there are strong prevailing winds. They

grow in sandy places as well as on stony ground. They will, however, not grow in localities where the sub-soil is too brackish nor will they stand much frost, and hence seldom grow at above 3,000 feet. Cashew trees are usually propagated from well-dried nuts (dried for about 12 days) but they can also be propagated by grafting which ensures that the new plants are true to type. The nuts may be planted *in situ*, but unless they are planted deeply (at least 5 inches) they are frequently destroyed by vermin, insects, etc. A more satisfactory method is to raise the plants in nurseries, but as the seedlings do not transplant well they are germinated in palmyrah baskets which are about 9 to 12 inches deep and 4½ inches in diameter. One nut is placed in each basket just below the surface of the soil with the stalk end upwards. Germination takes place in 8 to 10 days.

Shade must be provided until the seedlings have grown three or four leaves and they are watered often enough to keep the soil moist. The seedlings are ready for transplanting after about a month when the tap-root is too long to remain in the basket; by this time the seedling has four to five leaves. Holes of sufficient size to take one plant each are dug in the open and the seedlings are planted out. It is often advisable to have two or three seedlings in each hole and after a year to leave only the most vigorous; in this way losses due to transplanting, etc., may be reduced. The seedlings are pot-watered from small wells, dug alongside them, once every two days and after a month once every four days until the wet season arrives. Watering is done only in the morning, about 2 gallons being given to each plant. After the wet season watering is restarted for about another nine months or so when no more watering is necessary.

There is no definite spacing adopted for planting cashews; often there are not more than about 15 per acre. In windy places 50 × 50 ft. is not too wide, but in sheltered places 40 × 40 ft. could be adopted. The seedlings should be planted out 20 × 20 ft. and thinned out further when 7 to 10 years old. The cashew tree grows with a minimum of attention and no cultivation is usually done after planting. The tree responds to good cultivation but it is not known to what extent this can be economically carried out. The plants usually begin to bear from the third year and continue until the fifteenth year, when they generally die, but in some regions the trees may live over twenty years, and may also come into bearing earlier than the third year.

No figures for the average yields of cashew trees at various ages are available, but the following figures give some idea of the crop obtained from mature trees. It is reported that the good large nut varieties produce about 4,000 nuts per tree, the medium varieties 5,000, and the smallest about 6,000; or about 80 lb. in each case. In parts of India the yield is reported as only about 20 lb. per tree though there are individual trees which give as much

as 100 lb. It is stated that it is characteristic of the cashew trade for phenomenally large crops of one or two years to be followed by very poor ones.

The nuts consist of an outer shell which covers a soft honey-comb structure which occurs between it and the inner pink skin which surrounds the kernel. The honey-comb structure contains a dark coloured viscous liquid with vesicant properties, known as cashew nut shell oil. The nuts contain about 35 per cent. of shell oil and 30 per cent. of kernel. For the preparation of the kernels, the native method is to roast the nuts. In modern factories the shell oil is recovered mechanically. The kernels thus obtained are not free from their covering pink skin. This is removed by first drying the kernels, the skins being then carefully rubbed off by hand ; women and children do this work. For full information relating to the shell oil, its preparation and uses, see this BULLETIN, 1946, **44**, 17. The kernels are dried in air ovens, maintained at 120° F. for three hours, on wire trays. After peeling, the kernels are spread on cement floors in order that they may absorb some moisture and so become less brittle and less liable to damage during transit. On shelling, about 25-30 per cent. of kernels are obtained which yield about 80-90 per cent. of peeled kernels. Shelling usually results in 75-89 per cent. of whole and 11-26 per cent. of broken kernels.

The main use of cashew kernels is for dessert purposes. Most of the kernels exported from India go to the United States, where there is a large marketing organisation.

At the present time India is the main exporter of cashew kernels, and prepares them not only from her own produce but also probably from nuts imported from East Africa. The quantities of these unshelled nuts exported into India from East African countries during recent years are shown in the following table :

EXPORTS OF CASHEW NUTS

	Portuguese East Africa (from Mozambique).			Tanganyika Territory		Kenya & Uganda.
	Total. *Cwt.*	to British India. *Cwt.*	to Portuguese India. *Cwt.*	Total. *Cwt.*	To India. *Cwt.*	Total.* *Cwt.*
1938 .	506,761	484,977	17,034	21,880	n.a.	280
1939 .	572,930	533,692	36,890	18,280	n.a.	640
1940 .	623,896	564,536	59,342	30,249	9,881	780
1941 .	771,792	771,792	—	24,318	20,951	960
1942 .	201,365	201,354	—	3,238	3,187	880
1943 .	14,634	14,610	—	282	—	420
1944 .	137	117	—	14,754	9,255	920

n.a.—*not available.*

* *The countries to which these nuts were exported are not specified.*

In addition to these imports, India also received 400 tons of unshelled nuts from Brazil in 1940.

The quantities of cashew *kernels* exported from India during the most recent years for which statistics are available were:

	1937-8. Cwt.	1938-9. Cwt.	1939-40. Cwt.
Total	254,900	269,980	256,960
of which to—			
United States	214,700	220,980	204,260
United Kingdom	12,240	14,500	23,160
Canada	5,420	7,540	10,680
Netherlands	6,600	5,680	4,720
Belgium	2,800	6,360	2,780
France	6,680	8,140	2,900

Bibliography

Anon. "The Cashew Nut." *Dept. Agric., Ceylon. Leaflet No.* 109, 1937, 4 pp.

Sayed, I. A. "The Development of the Cashew-nut Industry in India." *Agriculture and Livestock in India*, 1939, **9**, Pt. 1, 26.

Jordan, C. C., and Crone, D. R. "India's Cashew Industry." *Foreign Commerce Weekly*, 1942, **8**, No. 6, 4.

Morada, E. K. "Cashew Culture." *Philippine Journal of Agriculture*, 1941, **12**, No. 1, 89.

Paul, W. R. C., and Canagaratnam, C. "The Production of Cashew Nuts in Mannar." *Tropical Agriculturist* (*Ceylon*), 1937, **88**, No. 1, 6.

Rector, T. H. "Science Vitalises Cashew-nut Production." *Food Industries*, 1931, **3**, No. 4, 150.

Subrahmanya Sarina, A. H. "Cashew-Nut: Its Cultivation and Marketing on the Malabar Coast." *Madras Agricultural Journal*, 1932, **20**, No. 6, 223.

I. C. S.

Sabadilla as an Insecticide.—In the search for insecticidal materials of plant origin, which could be substituted for rotenone and pyrethrum during the scarcity of these materials brought about by war conditions, one which has shown most promise and is reported on favourably in the United States is sabadilla seed.

Sabadilla is a member of the Liliaceae family belonging to the genus *Schoenocaulon* and is a widely distributed plant occurring mainly in Central America, Venezuela and Peru. There are a number of species, the chief being *S. officinale* of the tropical countries. *S. drummondii*, *S. texanum* and *S. dubium* are indigenous to the United States.

Sabadilla has long been known for its medicinal and insecticidal value, its chief use in this country having been as a parasiticide for controlling vermin in the hair. There are records of its employment for dealing with pests of livestock, the powdered seed having been reported as a great stand-by of farmers in America for treating cattle lice and ticks. It has also been mentioned in the past as an insecticide for a number of other pests, including soil-inhabiting worms, plant lice, chewing insects, green bugs, grasshoppers, roaches, bees and webworms. A German-patented preparation comprising rotenone and sabadilla, for which mixture a synergistic action was claimed, was reported in 1939 to be useful in combatting cabbage worms and tent caterpillars.

In 1938 a series of investigations was initiated at the University of Wisconsin and has continued over recent years, to test the value of sabadilla as an insecticide for crop pests and to discover methods for improving its effectiveness. The results of these experiments and those of other workers on the subject have, from time to time, been published chiefly in *The Journal of Economic Entomology* and other American publications, and a brief review is given below:

Sabadilla seed owes its toxicity to the group of alkaloids it contains, which amount to approximately 0·6 per cent. and consist of a mixture of cevadine, veratridine, cevine, cevadilline and sabadine. This alkaloidal mixture is generally referred to as veratrine. The two most toxic constituents from an insecticidal point of view appear to be veratridine and cevadine.

During the course of the work at Wisconsin it was found that kerosene extracts of sabadilla seed were highly toxic to house-flies and compared favourably in kill and knock down with other kerosene types of sprays such as pyrethrum. It was, however, observed that samples of seed varied in their biological activity, the most effective being those in which the seed was originally obtained in a powdered condition. Freshly ground seeds were found to be practically inactive. Numerous experiments were carried out to determine means for increasing the effectiveness of such non-toxic material and a satisfactory method was found to be a heat and/or alkali treatment. The application of heat during extraction increased the toxicity of freshly-powdered seed to a remarkable degree and at 150° C. the maximum toxicity was reached. Heat applied to the powdered seed and treatment with soda ash prior to extraction also increased the toxicity considerably and a combination of both soda ash treatment and reduced heat during the process of extraction was effective.

In further studies which were conducted to determine whether sabadilla might advantageously be employed in the form of dusts for controlling other insects it was also found that the heat and/or alkali treatment of the seed was efficacious giving an increased insecticidal action with a minimum amount of seed. The insects used in these tests were the milkweed bug (*Oncopeltus fasciatus*) and the red-legged grasshopper (*Melanoplus femur-rubrum*). These processes to enhance or render active the insecticidal principle of the natural seed have been covered by patents in the United States. One of the specifications in this connection includes the addition to the extract of a small quantity of lethane (an organic thio-cyanate) which is stated to exhibit a synergistic effect increasing the toxicity considerably.

The trials which have been made with sabadilla for the control of economic pests have mostly been of a preliminary nature but in one instance at least it proved of outstanding value in meeting an emergency in the vegetable canning industry in Wisconsin, where

it is reported that a million pounds of sabadilla dusts were employed for controlling such insects as leaf hoppers in string beans and other vegetable crops.

Among pests for which sabadilla seems to offer promise for control are the following: the squash bug (*Anasa tristis*), the chinch bug (*Blissus leucopterus*), the cabbage worm (*Pieris rapae*), the cabbage looper (*Autographa brassicae*), the green stink bug (*Acrosternum hilaris*), the harlequin bug (*Murgantia histrionica*), the green clover worm (*Platythpena scabra*), the Mexican bean beetle (*Epilachna varivestis*) and some value is indicated against *Lygus* spp.

A sabadilla dust with the addition of sulphur was found by workers in New York to be nearly as effective as rotenone in controlling cattle lice. In Peru a factory has been set up to manufacture an insecticide called "Babbini" which is composed of sabadilla, chili pepper, arsenic and quicklime and is used against pests of cotton.

In tests carried out to control the Saratoga spittle insect (*Aphrophora saratogensis*) on jack pine in the Lake States sabadilla dust, when freshly applied, was very toxic but it did not retain its toxicity when exposed on the trees.

In a limited series of field trials carried out in Trinidad in 1945 against the froghopper of sugar cane (*Tomaspis saccharina*) a commercial preparation of sabadilla gave considerable control and the fact that populations of the insect did not attain a serious level after application of the dust seemed to show that the insecticide exhibits some residual effect on this insect.

Bibliography

Matthysse, J. C., and Schwardt, H. H., *J. Econ. Ent.*, 1943, **36**, No. 5, 718.
Allen, T. C., Dicke, R. J., and Harris, H. H., *J. Econ. Ent.*, 1944, **37**, No. 3, 400.
Fisher, E. H., and Stanley, W. W., *J. Econ. Ent.*, 1945, **38**, No. 1, 125.
Allen, T. C., and Brunn, L. K., *J. Econ. Ent.*, 1945, **38**, No. 3, 291.
Allen, T. C., Link, K. P., Ikawa, M., and Brunn, L. K., *J. Econ. Ent.*, 1945, **28**, No. 3, 293.
Brunn, L. K., and Allen, T. C., *J. Econ. Ent.*, 1945, **38**, No. 3, 392.
Fisher, E. H., and Allen, T. C., *J. Econ. Ent.*, 1945, **38**, No. 3, 392.
Anderson, R. F., *J. Econ. Ent.*, 1945, **38**, No. 5, 564.
Walton, R. R., *J. Econ. Ent.*, 1945, **38**, No. 6, 713.
Frazier, N. W., *J. Econ. Ent.*, 1945, **38**, No. 6, 720.
Pickles, A., *Trop. Agric., Trin.*, 1946, **23**, No. 1, 9.
Wallace, M. D., *Amer. Soc. Hort. Sci. Proc.*, 1945, **46**, 284.

R. M. J.

BOOK REVIEWS

HONEY BEES AND THEIR MANAGEMENT. By S. B. Whitehead. Pp. 153, 9 × 5½. (London: Faber and Faber, Ltd., 1945.) Price 12*s.* 6*d.*

This new book on honey bees and their management could be read with advantage by all those interested in bees, whether beekeepers or not, for there is much in the book of general interest. The author states that the book is written especially for the small scale beekeeper rather than the professional apiarist, but many of the latter will probably find useful reading at least in the second part of the work.

The book is arranged in two parts, the first being a very readable account of beekeeping describing the life of the honey-bee, the management and maintenance of health in the colony. It is interesting to learn that out of over 70,000 species of insects known, the honey-bee is the only one domesticated by man and that this insect was known to the Egyptians as long ago as 3500 B.C.

The old-fashioned "skep," or straw hive, is little used these days except on the continent, standardised wooden hives having replaced them almost entirely in this country. There are several types of hive available but the important point is that all the hives in an apiary should be of the same type since then all the parts will be interchangeable. Bees suffer, in common with most animals, from a number of diseases, most of which can be prevented, even if not cured. Of all these disorders American foul brood is the most serious, being very highly contagious. The safest policy is to destroy all infected colonies, even though this means a serious loss to the beekeeper.

The second part of the book is a series of eight short chapters on technical and advanced topics. The first is a useful, though highly condensed, account of bee anatomy, the last is a bee bibliography. Dr. Whitehead makes a plea for extended beekeeping in this country for, as he points out, the value of the honey obtained by the apiarist is but a small part of the benefit derived from the honey-bee. Their value as pollinators to our fruit crops alone has been estimated at £4,000,000. The bee population in 1944 was 50,000 colonies and the author considers that at least four times that number could be supported by our farms, orchards and gardens. In conclusion, this volume is most attractively illustrated by photographs with, in addition, charts and diagrams. The printing and binding are also excellent.

I. C. S.

THE FORAGE RESOURCES OF LATIN AMERICA—EL SALVADOR. By James M. Watkins. Bulletin 35 of the Imperial Bureau of Pastures and Forage Crops. Pp. 24, 9½ × 7¼. (Imperial Agricultural Bureaux, Central Sales Branch, Penglais, Aberystwyth, 1946.) Price 2*s.* 6*d.*

This Bulletin is the first in a series to be published on the forage resources of Latin America. After a brief introduction in which

are described the climatic conditions prevailing in El Salvador and the nature of the soil and the uses to which the land is put, the common forage plants which occur in this country are discussed. These consist of 22 different kinds of grasses, ten legumes and three miscellaneous plants. In general, under each item are given particulars of the climatic and other conditions which are most suitable for its growth; the method of propagation; the extent of its utilisation and its value as a forage plant. No botanical description of the plants is given but mention is made where such information may be found. From the discussion of these forage plants it is concluded that the forage situation in El Salvador could be improved by the use of more legumes, especially browse legumes, such as barajillo (*Desmodium rensoni*); the use of more grass—legume mixtures, as this practice has these advantages, among others, of increase in yield per unit area, a more desirable feed, better stands and a better control of weeds. More efficient pasture management is advocated whereby the carrying capacity of the available land could be greatly increased and the stock considerably improved. Investigations are necessary to demonstrate to what extent the use of fertilisers can be used economically. Each particular type of region should grow the most suitable plant. Finally, provision should be made for supplies of forage to be available in the long dry season, such as, by means of silage or the preservation of feed as hay. In this way the major forage problem of El Salvador could be solved.

G. T. B.

FORESTS AND FORESTRY IN GREAT BRITAIN. By William Ling Taylor, C.B.E. Pp. ix + 172, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Crosby Lockwood & Son, Ltd., 1945.) Price 12*s*. 6*d*.

The aim of this book is to meet the need for an outline of forest history and forestry in Great Britain and the bearing our national forestry policy will have on the future welfare of the British people. The author, who is a member of the Forestry Commission and formerly Assistant Forestry Commissioner for England and Wales, and Deputy Surveyor of the Forest of Dean, is well qualified for the task he set himself and well he has succeeded.

The book has come at an opportune time when so much interest and attention is being given to the need to repair the great devastation to our forests caused by the events of the last six years, and it will commend itself to the general reader on account of the clear and attractive manner in which it is written, and its freedom from technicalities.

In the fifteen chapters which the book contains, and with the aid of excellent illustrations, is presented a full and most interesting account of our British forests, which shows the means by which they are raised and conserved for man's service and enjoyment, the produce obtained from them and their value in other respects.

The increasing importance of forestry in our national economy is stressed, it being pointed out that forests give security and that, for defence purposes, we must have timber resources growing on British soil.

In the last chapter entitled " Does Timber Famine Threaten ? " the author does not take quite such a gloomy view as some other authorities, but gives a grave warning that the world's forestry resources are diminishing and if a serious famine is to be averted in the not too distant future, restraint must be exercised in the use of wood, until such time as the new forests, which are being established in many countries, begin to yield.

There is a good index to the book. R. M. J.

NATIONAL FRUIT TRIALS, 1921-1944. By J. M. S. Potter, N.D.H. Pp. 56, $9\frac{3}{4} \times 6\frac{1}{4}$. (London: The Royal Horticultural Society.) Price 5s.

The National Fruit Trials were established in 1921 in the grounds of the Royal Horticultural Society's gardens at Wisley, in Surrey. There were a number of good reasons for the choice of this site, although Wisley does not provide an ideal situation for fruit—the soil is quite unsuited to cherries—and the actual fields used are so low-lying that the incidence of frost damage has been a severe handicap. In this connection it seems unfortunate that the trial grounds were not provided with a separate meteorological station. In fact, the present intention of the Ministry of Agriculture is to transfer gradually this most important work to a new situation. Initially the trials were instituted in conjunction with the Ministry, who shared the cost with the Society; there followed a period when some part of the cost was met from official funds, but at the present time the Society is responsible for the trials and for any expenses incurred. The Royal Horticultural Society deserves all credit for its part in what has been achieved, and for this critical contribution to the knowledge of potential commercial varieties.

The object of these trials has been to test out new and promising varieties for the commercial grower against the existing standard varieties. With fruit a number of years is required to obtain experimental results and many factors in addition to yield—e.g. flavour, market suitability—are of serious account. Already with most fruits several likely commercial varieties have been discovered in the course of these experiments. In addition to the account of the trials, the work includes in several appendices observations made on a number of varietal characters, i.e. on the flowering periods of certain apples, pollen compatability of apples, plums and pears, sulphur-shy varieties, synonyms, susceptibility of apples to frost, a tentative classification of black currants and bacterial canker of plums. A list is also included of the very large collection of hardy fruit varieties at present maintained at Wisley.

E. H. G. S.

THE HORTICULTURAL INDUSTRY IN THE DOMINIONS AND THE UNITED STATES OF AMERICA. Giles Tuker. Pp. viii + 119, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: National Farmers' Union, 1946.) Price 5s.

The author of this publication, who is a horticulturist, was a member of a delegation representing the Farmers' Unions of the United Kingdom that visited Canada, Australia, New Zealand and the United States during the winter of 1944-5. In the course of the tour he paid particular attention to fruit and vegetable growing. The results of his observations, together with information regarding costs, etc., are here recorded, and, in addition, certain overseas bulletins and statements are reprinted.

In the main, the data collected relates to fruit. The work opens with accounts of the vegetable industry and fruit growing in New Zealand. There follow observations on Australia, Canada and the Wenatchee area of the United States. Next in sequence comes a description of Grower Co-operative Organisation in British Columbia, from an address by Mr. A. K. Lloyd, of Nova Scotia; brief sections by the author on Horticultural Machinery and Packhouses; a reprint of Bulletin No. 446 of the Washington Agricultural Experiment Station, which provides apple production costs for the State of Washington; a statement on Fruit Growing Costs in New Zealand; various packing costs; and a tabulated orchard survey of the Okanagan (B.C.) Horticultural District. The work concludes with "A Census of Nova Scotia's Apple Orchards," apparently a reprinted Nova Scotian bulletin.

The work is full of facts that will be of interest to the United Kingdom grower, and, in particular, a valuable series of cost figures are brought together in its pages. The grower here will be reassured to note that Mr. Tuker did not find these fruit industries ahead of the best United Kingdom practice. Apple production in the areas visited is generally not expanding, though a considerable area of young apple trees was seen in British Columbia. The codlin moth is a severe pest nearly everywhere. In some areas six or seven sprayings with lead arsenate are necessary, while in the Hawkes Bay district of New Zealand orchards are now sprayed once a week from December to February inclusive. Cox's Orange Pippin does not seem to be a commercial success in these countries. Experience shows that packing houses can be too large for economic working.

Undoubtedly this is a very useful publication, and it is well illustrated. It is excellently printed, but there do, however, appear to be one or two minor editorial imperfections. It seems that the costs data on pages 73-76 relate to the "Fruit Growing Costs" statement on the preceding pages; if so, this is not made clear. Moreover, from the Contents List these appear to be separate sections. On page vi there seems no reason for the lower case adopted for the Horticultural Machinery and Packhouses sections, however brief these may be.

E. H. G. S.

Sunflower for Food, Fodder and Fertility. By E. F. Hurt. Pp. 155, 9 × 5½. (London: Faber and Faber, Ltd.) Price 10s. 6*d*.

During past years attempts have been made from time to time to cultivate oilseeds in England with a view to making this country less dependent upon imported materials. Experiments were carried out on a fair scale a few years ago to determine whether soya beans could be grown successfully in England, but unfortunately the results did not come up to expectations. This question of the production of oilseeds in this country assumed greater importance during the recent war, in view of the shortage of oils and fats, and among oil-bearing plants which were tried out was the sunflower.

Mr. Hurt, who has had considerable experience with these trials, for some time in association with Dr. G. E. Blackman, considers that the possibilities for the sunflower are so good that he feels that greater publicity should be given to the advantages of cultivating this oilseed crop, and has accordingly written this book with a view to increasing the interest of farmers in the production of these seeds.

The book is divided into three parts. The first chapter is devoted to a consideration of the importance of edible oils in the dietary of all nations and of the necessity for adequate supplies, emphasis being placed upon the great value of home-grown produce, particularly in time of war when imports may be curtailed, or even stopped. In the remainder of this first part the history and nature of the sunflower is described and information given regarding the uses to which this plant can be put. The seed is by far the most important part and is used as a source of an edible oil, the oil-cake being employed as a feeding stuff for animals. The seed is also used for poultry and other birds.

The second part is the most important in the book. In it are furnished the particulars the potential grower wants to know about the crop and its suitability for growing in England. As a preliminary a resumé is given of the results of the trials already carried out. Many varieties of sunflower have been tested, but only a few, mainly of the semi-dwarf type, have proved themselves suitable for cultivation in this country. The trials have indicated that the best regions lie south of a line drawn from the Wash to the Severn. In a further chapter instructions are given regarding the best methods of sowing and of cultivation. Pests and diseases most likely to be met are described. Of the former wireworms and green finches are the worst. There are only two diseases which are likely to prove troublesome. They are both of a fungous nature: sclerotina which attacks the stems about ground level and botrytis, or grey mould, which affects the heads. Methods are given for their control. For harvesting combine harvesters have proved satisfactory in some districts. Where these cannot be used, the plants have to be cut by hand and then stooked or fenced. After being

gathered the heads have to be threshed and dried. If the moisture-content cannot be reduced below 12 per cent. by exposure to the air, drying by artificial heat must be used, as seed with a moisture content of over 12 per cent. readily heats on storage and thereby becomes damaged.

The final part of the volume is devoted to chapters giving a brief description of the cultivation of sunflowers in overseas countries; analyses of the plant, its parts and residues; notes on selection and breeding; and on vernalisation of the seed.

Six appendices and a subject index complete the book. Among the former is a section on centralisation. This is a system which the author advocates as offering considerable advantages and in which the cultivation is centralised into areas, each of which would have its own threshing and drying plant. Two such areas already exist, one in Hertfordshire and the other in Leicestershire. A bibliography is another of the Appendices. Twenty excellent plates and nine diagrams serve as illustrations.

All those who are interested in the production of oilseeds, particularly sunflower seed, should study this book with its fund of relevant information. Farmers anxious to grow new crops should also read it. The author is to be congratulated upon his presentation of the subject, which he has adequately treated. It is hoped that as a result of his pioneer work others will be encouraged to take up the cultivation of sunflowers in England.

G. T. B.

PYRETHRUM FLOWERS. Supplement to Second Edition, 1936-1945. By C. B. Gnadinger. Pp. xiv + 310, 9 × 6. (Minneapolis, Minnesota: McLaughlin Gormley King Co., 1945.)

Since 1936 when the second edition of this standard work was published (see the review in this BULLETIN, 1936, **34,** 549) the use of pyrethrum and its importance as an insecticide have increased to a very large extent. It is, therefore, not to be wondered at that during the period since that date a large amount of work has been carried out on the cultivation of the flowers and their utilisation as well as on the investigation of the active constituents and their evaluation.

In this Supplement the author has collected together the more important of the articles published since 1936 and has grouped abstracts of or short references to them under the same headings as were given to the chapters of the second edition.

The first chapter is devoted to the commercial sources of pyrethrum. The greater part of this section deals with the production in Kenya, a country that now occupies the premier position as a producer. Belgian Congo and Brazil are two other countries from which the United States reckoned to import considerable quantities of pyrethrum flowers in 1945. The chapter on the active

principles of pyrethrum gives a survey of the research work that has been carried out of recent years by a number of observers and also contains sections on the action of pyrethrins on both cold and warm-blooded animals. Chemical methods for the evaluation of pyrethrum have made a considerable advance since 1936. The mercury reduction method has assumed great importance, especially since it was adopted by the Association of Official Agricultural Chemists and a number of tests have been carried out on this method in comparison with other methods. In view of its proved advantages over other methods, it is hoped it will become more universally used. Biological methods of evaluation have also received attention and some 50 pages are devoted to the progress made. The correlation of the results of assay obtained by chemical and biological methods are dealt with in a short chapter. Four chapters cover the recent literature on the manufacture of pyrethrum insecticides, livestock sprays and powders, dusts and sprays for horticultural purposes. In succeeding pages allotted to miscellaneous uses of pyrethrum considerable attention is drawn to the aerosol bomb and mosquito control. The final chapter records attempts to grow pyrethrum flowers in the United States. Very little headway has been made in this direction although it has been shown that pyrethrum flowers of good quality can be grown.

The book is illustrated with 28 photographic reproductions, and 12 inter-textual figures, and is furnished with 10 tables and an index. Its bibliography is very extensive, containing over 1,300 references.

This book is a valuable addition to the standard works on insecticides. It serves the very useful purpose of providing in one volume a resumé of the most important papers on pyrethrum published in the period 1936-45, and will be welcomed by all who have an interest in pyrethrum. Its value would have been enhanced if a critical survey of the work described had been included. Nevertheless, the author is to be congratulated on this book, which maintains the high standard set by the second and earlier editions.

G. T. B.

AN INTRODUCTION TO INDUSTRIAL MYCOLOGY. By G. Smith, M.Sc., F.R.I.C. Third Edition. Pp. xiv + 271, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Edward Arnold & Co., Ltd., 1946.) Price 20s.

In the third edition of this book, a number of minor alterations have been made and eleven new illustrations added; the layout of the book, however, remains the same. The previous edition was reviewed in this BULLETIN (1943, **41**, 194.) A whole chapter is now devoted to yeasts, an alteration well justified in view of their enormous economic importance, especially at the present time when

food-yeasts are being grown to supplement meagre rations in Europe and elsewhere.

By the new additions the total number of photomicrographs is brought up to 141. These form a series of clear, instructive illustrations which the author rightly considers to be more useful to a beginner than line diagrams.

It is unfortunate that when the present edition of this book was issued more information was not available for publication about the important war-time advances in the industrial uses of fungi, particularly in the preparation of antibacterials. The author was, however, able to include some details about penicillin while mention is made of other antibacterials derived from *Penicillium* and *Aspergillus* spp.

I. C. S.

TECHNIQUE DES PRODUITS DE BEAUTÉ. By R. M. Gattefosse and Dr. H. Jonquières. Pp. 229, 9½ × 6¼. (Paris: Girardot & Cie, 1946.)

This book is divided into five parts devoted respectively to (1) aesthetic and physiological considerations, more particularly concerning the various types of skin and their different characteristics; (2) classes of beauty preparations, in which the functions of true solutions, colloidal solutions, emulsions, suspensions and solid products are discussed; (3) the properties of some of the more recent raw materials used in cosmetology; (4) the manufacture of beauty preparations, including lotions, creams, grease paints, lipsticks, eye pencils and beauty packs; (5) aesthetic dermatology, where vitamin-therapy, hormone-therapy, and sulphur-therapy are reviewed. No index is provided, but the list of contents is sufficiently detailed to render this scarcely necessary.

Over half the volume is given over to the third and fourth parts where numerous useful formulæ are given, while throughout the whole work the many aspects of cosmetological science are fully discussed, authorities in the various fields being freely quoted.

The book can be recommended with confidence to anyone interested in the subject of cosmetology, either from the manufacturing or more general point of view.

H. T. I.

A REVIEW OF THE LITERATURE ON SOIL INSECTICIDES. By H. C. Gough, Ph.D. Pp. ii + 161, 10 × 6¾. (London: The Imperial Institute of Entomology, 1945.) Price 10s.

This comprehensive review of the literature on soil insecticides was compiled as the result of a request to the author from the Conference on Insecticides and Fungicides of the Agricultural Research Council, to correlate and investigate as much as possible

of the original experimental work carried out on soil insecticides. It was felt that, in view of the wide interest and great economic importance of the subject together with the contradictory results obtained on almost all the materials tried as soil insecticides, a review of existing information was desirable. The publication of this work has been entrusted to the Imperial Institute of Entomology by the Agricultural Research Council.

Dr. Gough has dealt only with soil insecticides and has omitted all references to soil sterilisation. In certain cases he has been unable to decide, on the evidence available, whether a substance which he has included acts as an insecticide or merely as a deterrent. He has excluded references to the control of insects by poison baits but has included those referring to the application of poisons to insects previously attracted to baits. He has found it necessary, in order to keep the text within reasonable proportions, to limit the number of references to some of the more common materials and, in general, references which do not give the amount of chemical or the area of application have been omitted.

Apart from the sections devoted to the introduction to and general considerations of the subject, the main part of the work on soil insecticides has been arranged under chemical headings and within these under insects. The more important chemicals already in common use are arranged alphabetically in one group while other substances tested as soil insecticides are arranged in the same way in a second group. The section dealing with general considerations has useful information on the methods of application of soil insecticides, their distribution in the soil, experimental methods of assessing toxicity and the effect of soil insecticides on plants and micro-organisms. The book has an extensive bibliography which is collected together at the end of the text.

H. E. C.

SCIENCE AND SCIENTISTS IN THE NETHERLANDS INDIES. Edited by Pieter Honig, Ph.D., and Frans Verdoorn, Ph.D. Pp. xxii + 491, $10\frac{1}{2} \times 7$. (New York: Board for the Netherlands Indies; London: Wm. Dawson & Sons, Ltd., 1945.) Price $4.00.

This work appears as a special supplement to *Natuurwetenschappelijk Tijdschrift voor Nederlandsch Indie*, Vol. 102, and contains original articles, and reprints of similar accounts previously published elsewhere—though not generally available in the English language—dealing with the development or status of various branches of the natural sciences in the Netherlands Indies up to the time of Japanese invasion. These contributions are supported by a number of travellers' impressions, shorter articles and notes, while a list of scientific institutions, societies and workers at that time is included.

The material was prepared during the war, when direct contact with both Holland and the Indies was impossible, but in spite of

such severe handicaps a useful history of scientific developments in these territories is provided, although the matter does not form quite as complete a history of science in the Netherlands Indies as the editors would have wished to present.

A series of five chapters by various authors provides a history of the establishment of cinchona. A valuable account of "Half a Century of Phytochemical Research" by D. R. Koolhaas is reprinted, as are two useful papers by E. C. J. Mohr: "Climate and Soil in the Netherlands Indies" and "The Relation between Soil and Population Density in the Netherlands Indies." M. J. Sirks' study of the active career of Rumphius is of considerable interest. Dr. H. Stauffer is responsible for a comprehensive article on the "Geology of the Netherlands Indies," while Dr. R. W. van Bemmelen has written a short article on the "Mineral Resources of the Netherlands Indies and their Industrial Possibilities." Other contributors deal with a variety of subjects including: medical research, prehistoric research, the position of veterinary science, and the history of rubber cultivation and research.

The work is well provided with illustrations. The editors and contributors have been careful to offer dispassionate accounts of the progress that had been achieved, but throughout there runs a vein of justifiable pride over the very considerable attainments of the Dutch in these territories.

E. H. G. S.

INDUSTRIAL RESEARCH, 1946. Advisory Editor: Professor E. N. da C. Andrade, F.R.S., D.Sc., Ph.D. Pp. 736, $8\frac{1}{2} \times 5\frac{1}{2}$. (London and New York: Todd Publishing Company, Ltd.) Price 21s.

This reference book has been added to the series of annual reference books put out by the publishers, and will be published each year. As the Advisory Editor says in his introduction, politicians, academic scientists and industrialists are to-day all concerned as to the application of science to industry and are anxious to gain more information as to present trends and future possibilities. Further, they seem to need a book, where in addition to this information, they can readily find particulars of the chief industrial laboratories and research associations, of Government departments and of other institutions concerned with industrial research. From the nature of some of the inquiries dealt with at the Imperial Institute it is clear that when industrialists wish to have research undertaken in their own line of business, one of their chief difficulties is to know where to start, where to obtain advice, and on what lines to proceed. This book will assist them and save them time. It will show them what is being done by others and how it is being done, and is to be recommended to all interested in industrial research.

The first two sections of the book are composed of articles by distinguished scientists and technicians, both in this country and the U.S.A., on the general trends of research in a variety of industries such as, to take a few at random, "Progress in the Electrical Industry," "Radar in War and Peace," "Research in Mechanical Engineering," "Recent Advances in Paints and Varnishes in U.S.A.," "Training for Research." These articles are not too technical but give a review of the trend of research in the industries dealt with.

Sections 3 to 5 form a directory of Official Bodies connected with research in this country, the British Empire and the U.S.A., and of over 100 Research Associations in this country carrying out research in various trades, in which particulars are given of the work they do, their addresses and staff. Section 6 contains particulars of Officially Appointed Committees, with their terms of reference, and their recommendations, and Section 7 is a directory of the many Organisations interested in Industrial Research.

Section 8 deals with the facilities available for those who are interested in making industrial research their career, and a review is given of the possibilities in various industries such as engineering, mining, plastics, etc. One of the most useful sections is Section 10, which gives a selected list of Books and Periodicals devoted to various trades, and also a most useful feature, a list of films, with the length, size and name of the distributors. The list does not claim to be exhaustive, but to those who wish to keep up to date with developments in their own and related industries, and to encourage their staff to do the same, this section will be helpful. Finally, Section 11 is a brief "Who's Who" of Industrial Research.

This book is a welcome addition to the series of annual reference books.

R. H. K.

BIBLIOGRAPHY

Compiled by Miss R. M. Johnson

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the three months February-April 1946.

*The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.*1. *Applications for the Dominion and Indian Governments publications may be made to the Offices of the High Commissioners or Agents-General in London.*

AGRICULTURE

General

Report of the National Institute of Agricultural Engineering for the year ending August 31, 1945. Pp. 12, 8½ × 5½. (York: National Institute of Agricultural Engineering, 1946.) Price 3*d*.

Report of the Board of Agriculture, Isle of Man, for the year ended March 31, 1945. Pp. 40, 9¾ × 7¼. (Douglas, I.O.M.: Board of Agriculture, 1945.)

Report of the Queensland Acclimatisation Society, Queensland, 1944-45. Pp. 8, 8 × 5. (Brisbane: Queensland Acclimatisation Society, 1945.)

Report of the Department of Agriculture, Tasmania, for 1944-45. Pp. 17, 13 × 8. (Hobart: Government Printer, 1945.)

Annual Report of the Department of Science and Agriculture, Barbados, for the year ended March 31, 1945. Pp. 17, 9½ × 7. (Barbados: Government Printer, 1945.)

Report of the Minister of Agriculture, Canada, for the year ended March 31, 1945. Pp. 212, 9¾ × 6½. (Ottawa: King's Printer, 1945.) Price 50 cents.

Annual Report of the Ontario Agricultural College and Experimental Farm for 1944. Pp. 97, 9¾ × 6½. (Ottawa: King's Printer, 1945.)

Annual Report of the Department of Agriculture, Dominica, for 1944. Pp. 11, 9 × 6¼. (Roseau, Dominica, B.W.I.: Government Printer, 1945.)

Ecuador's Agriculture and the War. By K. H. Wylie. *Foreign Agric.*, 1946, **10,** No. 2, 18-32.

Annual Report of the Minister for Agriculture, Eire, for 1944-45. Pp. 228, 9¾ × 8. (Dublin: Government Publications Sale Office, 1946.) Price 3*s*. 6*d*.

Report on the Department of Agriculture, Gold Coast, 1944-45. Pp. 8, 13 × 8. (Accra: Government Printing Department, 1945.) Price 1*s*.

Annual Report of the Imperial Council of Agricultural Research, India, 1944-45. Pp. 45, 9¾ × 6¼. (Delhi: Manager of Publications, 1945.) Price Rs. 2 As. 2.

Annual Report of the Department of Agriculture, Mauritius, for 1944. Pp. 30, 9½ × 6½. (Port Louis: Government Printer, 1945.) Price 50 cents.

Annual Report of the Department of Agriculture, Northern Rhodesia, for 1944. Pp. 12, 13 × 8. (Lusaka: Government Printer, 1945.) Price 1*s*.

Report of the Department of Agriculture, St. Vincent, for 1944. Pp. 8¼ × 6½. (Kingstown: Government Printing Office, 1945.)

Annual Report of the Department of Agriculture, Sierra Leone, for 1944. Pp. 15, 9¾ × 6¼. (Freetown: Government Printer, 1945.)

Biological Control of Prickly Pear. By F. W. Pettey. *Frmg. S. Afr.*, 1946, **21,** No. 238, 31-33.

The Soil

Report of the Soil Conservation Committee, Sudan Government, 1944.

Pp. 174, $9\frac{1}{2} \times 7$. (Khartoum: Department of Agriculture and Forests, 1945.)

Soil-Fertility Maintenance under Different Systems of Agriculture. By H. L. Richardson. *Emp. J. Exp. Agric.*, 1946, **14**, No. 53, 1-17.

Pests—General

(For Insecticides of Vegetable Origin see p. 122.)

A Review of Twenty-five Years of Economic Entomology in the Island of Mauritius. By L. A. Moutia and R. Mamet. *Bull. Ent. Res.*, 1946, **36**, Pt. 4, 439-472.

Termite Control in Ontario. By E. B. Watson and R. W. Thompson. *Publ. No.* 36, *Div. Entomol., Dep. Agric. Canada.* Pp. 5, $8\frac{1}{2} \times 5\frac{1}{2}$. (Ottawa: King's Printer, 1945.)

DDT Dispersed from Airplanes for Control of Adult Mosquitoes. By A. W. Lindquist, A. H. Madden, C. N. Husman and B. V. Travis. *J. Econ. Ent.*, 1945, **38**, No. 5, 541-544.

DDT—Oil Sprays Applied from an Airplane to Control *Anopheles* and *Mansonia* Mosquitoes. By A. W. Lindquist and W. C. McDuffie. *J. Econ. Ent.*, 1945, **38**, No. 5, 545-548.

Some Uses of DDT in Agriculture. By H. Shaw. *Nature*, 1946, **157**, No. 3984, 285-287.

Tentative Recommendations for the use of DDT against Agricultural Pests in 1946. By W. A. Ross. *Publ. No.* 37, *Div. Entomol., Dep. Agric. Canada.* Pp. 5, $8\frac{1}{2} \times 5\frac{1}{2}$. (Ottawa: King's Printer, 1946.)

Preliminary Tests with DDT against Insect Pests of Food Crops in the Lesser Antilles. By R. G. Fennah. *Trop. Agric., Trin.*, 1945, **22**, No. 12, 222-229.

Using DDT in Food Factories for Long Insecticidal Effect. By J. Feiner. *Food Industr.*, 1945, **17**, No. 12, 76-79.

The New Insecticides DDT and Benzene Hexachloride and their significance in Agriculture. By H. Shaw. *J. Roy. Agric. Soc.*, 1945, **106**, 204-220.

DDT Compared with other Insecticides for Control of Hemipterous Insects on Cotton. By W. A. Stevenson. *J. Econ. Ent.*, 1945, **38**, No. 5, 531-533.

Insect Damage to Nylon. By R. L. Patton. *J. Econ. Ent.*, 1945, **38**, No. 5, 522-523.

Foodstuffs—General

Tables of Food Composition in Terms of Eleven Nutrients. *Misc. Publ. No.* 572, *U.S. Dep. Agric.* Pp. 30, 9×6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Prepared by the Bureau of Human Nutrition and Home Economics in co-operation with the National Research Council.

Vanillic Acid Esters as Food Preservatives. By I. A. Pearl and J. F. McCoy. *Food Industr.*, 1945, **17**, No. 12, 88-91, 230.

Beverages

Annual Report of the West African Cacao Research Institute, Tafo, for the year ended March 31st, 1945. Pp. 34, 13×8. (Tafo, Gold Coast: Cacao Research Institute, 1946.) Mimeographed.

Report and Proceedings of the Cocoa Research Conference held at the Colonial Office, May-June, 1945. *Col.* No. 192. Pp. 168, $9\frac{1}{2} \times 6$. (London: H.M. Stationery Office, 1945.) Price 3*s*.

Note Préliminaire sur une Nouvelle Maladie du Cacaoyer le "Swollen Shoot." By H. Alibert. *Agron. Trop.* 1946, **1**, Nos. 1-2, 34-43. Contains notes on the incidence of the disease in the Ivory Coast.

Mechanization of Field Work on a Coffee Plantation. By R. W. Barrett. *Mthly. Bull. Coffee Brd. Kenya*, 1946, **11**, No. 121, 5-8.

Cereals

The Amounts of Vitamin B1 in Cereals and the Extent to which they Supply Human Requirements in various Dietaries. By W. I. M. Holman. *Nutr. Absts.*, 1946, **15**, No. 3, 387-410.

Principles of Cereal Storage. By F. P. Coyne. *Publ. Dep. Food, India.* Pp. 45, 9½ × 6½. (Delhi: Manager of Publications, 1945.) Price As. 6.

Report on the Marketing of Barley in India. *Marketing Series No.* 51. (Delhi: Manager of Publications, 1945.) Price Re. 1 As. 4.

Amioca—The Starch from Waxy Corn. By H. H. Schopmeyer. *Food Industr.*, 1945, **17**, No. 12, 106-108.

The Place of Minor Elements in Rice Growing. By S. P. Aiyar. *Indian Frmg.*, 1946, **7**, No. 1, 11-14.

Vitamin B1 in Fortified and Natural "High Vitamin" Flours. By J. J. C. Hinton. *Chem. and Ind., Lond.*, 1946, No. 9, 94-97.

Wheat in the Middle East. By H. H. Mann. *Emp. J. Exp. Agric.*, 1946, **14**, No. 53, 31-42.

Pulses

Effect of Freezing Rate on Vegetables. Appearance, Palatability and Vitamin Content of Peas and Snap Beans. By F. A. Lee, W. A. Gortner and J. Whitcombe. *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 3, 341-346.

Pea Diseases and Their Control. By L. L. Harter, W. J. Zaumeyer and B. L. Wade. *Frms.' Bull. No.* 1735, *U.S. Dep. Agric.* Pp. 28, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 10 cents.

Dried Peas. By R. W. Shorrock. *Agriculture*, 1946, **52**, No. 12, 530-534. Discusses suitable varieties, cultivation and marketing.

Sugar

Forty-Fifth Annual Report of the Bureau of Sugar Experiment Stations, Queensland, 1944-45. Pp. 27, 13 × 8. (Brisbane: Government Printer, 1945.)

Brazil's Sugar Industry. By H. Maness. *Agric. in Americas*, 1945, **5**, No. 12, 223-226.

Fifteenth Annual Report of the Sugarcane Research Station, Mauritius, for 1944. Pp. 23, 9½ × 6. (Port Louis: Government Printer, 1945.) Price 50 cents.

Cotton Bags for Storing Sugar. By D. L. Sen and Nazir Ahmad. *Indian Frmg.*, 1945, **6**, No. 11, 516-518.

Root Crops

Handling and Shipping Early Potatoes. By D. H. Rose. *Circ. No.* 744, *U.S. Dep. Agric.* Pp. 44, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 10 cents.

The Potato Products Industry. By A. E. Williams. *Synthetics and By-Products*, 1946, **8**, No. 3, 77-83. Continental practice is described in this article.

Sweet Potato Gels—Something New. By G. L. Baker and C. W. Woodmansee. *Food Industr.*, 1946, **18**, No. 2, 106-107. Gives particulars of the uses and methods of manufacture.

Fruits

Bush Fruits. By D. S. Blair and M. S. Davis. *Publ. No.* 775, *Dep. Agric. Canada.* Pp. 22, 9¾ × 6½. (Ottawa: King's Printer, 1945.)

Citrus Tree Pruning. *J. Dep. Agric. W. Aust.*, 1945, **22**, No. 3, 210-221.

Irrigation of Citrus in the Lower Murray Valley. By F. M. Read. *J. Dep. Agric. Vict.*, 1945, **43**, Pt. 12, 503-508.

Controlling Orange Decay. Thiourea, Thioacetamide, 2-Aminothiazole and Quinosol in Aqueous Solution. By J. F. L. Childs and E. A. Siegler. *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 1, 82-87. Describes work carried out to control stem-end rots and blue and green molds.

Date Production and Packaging. By E. Hardy. *Food Manuf.*, 1946, **21**, No. 4, 165-168.

Precooling California Grapes and Their Refrigeration in Transit. By W. T. Pentzer, C. E. Asbury and W. R. Barger. *Tech. Bull. No.* 899, *U.S. Dep. Agric.* Pp. 64, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 15 cents.

Guava Varieties in South Africa. By F. J. H. le Riche. *Frmg. S. Afr.*, 1946, **21**, No. 238, 9-17.

Peach Mildew. By A. J. Louw. *Frmg. S. Afr.*, 1946, **21**, No. 239, 93-99.

The Cool Storage of Peaches and Pears for Canning to Extend the Season. By E. G. Hall. *Agric. Gaz. N.S.W.*, 1946, **57**, Pt. 2, 81-83.

Loss of Added Vitamin C in the Storage of Frozen Peaches. By C. W. Du Bois and D. L. Colvin. *Fruit Prod. J.*, 1945, **25**, No. 4, 101-103.

Production of High Quality Tomato Seed. For Farm and Commercial Use. Contributed by the Division of Plant Industry. *Agric. Gaz. N.S.W.*, 1945, **56**, Pt. 12, 545-548.

An Electric Pollinator for Tomatoes. By W. Cottrell-Dormer. *Queensld. J. Agric. Sci.*, 1945, **2**, No. 3, 157-169.

Strawberry Culture. By C. N. Morgan. *Queensld. Agric. J.*, 1945, **61**, Pt. 6, 330-339.

Fruits Tropicaux et Subtropicaux d'Importance Secondaire. By J. F. Leroy. *Rev. Bot. Appl.*, 1944, **24**, 34-50; 171-220. Deals with the avocado, mango, papaw, litchi, mangosteen, guava and custard apple.

Preparation and Preservation of Fruit and Vegetable Products. By G. S. Siddappa and A. M. Mustafa. *Misc. Publ. No.* 63, *Imp. Coun. Agric. Res. India.* Pp. 24, 9½ × 7¼. (Delhi: Manager of Publications, 1946.) Price As. 12.

Storage of Dried Fruit. Influence of Moisture and Sulfur Dioxide on Deterioration of Apricots. By E. R. Stadtman, H. A. Barker, E. M. Mrak, G. MacKinney. *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 1, 99-104.

Storage of Dried Fruit. Gas Changes during Storage of Dried Apricots and Influence of Oxygen on Rate of Deterioration. By E. R. Stadtman, H. A. Barker, V. Haas, E. M. Mrak and G. MacKinney. *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 3, 324-329.

Vegetables

Cabbages, Brussels Sprouts and Miscellaneous Green Crops. *Bull. No.* 132, *Minist. Agric., Lond.* Pp. 30, 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 1*s*.

Fodders and Forage Plants

Grazing and Pasture Research in India. *Indian For.* 1946, **72**, No. 1, 1-5. A paper, prepared by the Indian Central Silviculturist, read at the 6th Silvicultural Conference, Dehra Dun, 1945.

The Rothamsted Experiments on Mangolds, 1876-1940. Part IV. The Composition of the Mangolds grown on Barnfield; (i) The Dry-Matter Content of Leaves and Roots. By D. J. Watson. *Emp. J. Exp. Agric.*, 1946, **14**, No. 53, 49-56.

Pampas Grass. *N.Z. J. Agric.*, 1945, **71**, No. 5, 471-476.

Pampas Grass Trial in Southern Tasmania. By F. E. Ward. *Tasm. J. Agric.*, 1945, **16**, No. 4, 152-154.

The Preparation of Refined Rice Bran. By J. Duckworth and J. M. Dent. *Trop. Agric., Trin.*, 1946, **23**, No. 2, 25-28.

Oils and Oil Seeds

Brazil's Oil-yielding Palms. By M. L. Bomhard. *Agric. in Americas*, 1946, **6**, No. 1, 6-9, 14-15.

Coconut Products and the Plastics Industry. By G. B. E. Schueler. Pp. 7, 8½ × 5½. (London: J. H. Vavasseur & Co., Ltd., 1946.) Reprinted from *Plastics*, February, 1946.

Ground-nut Proteins in the Sizing of Papers. By Chattar Singh and Kartar Singh. *Indian For. Bull. No.* 126, 1945 (*Utiliz.*). Pp. 14, 9 × 5¾. (Dehra Dun, U.P.: The Forest Research Institute, 1945.) Price As. 9.

Première Étude sur une Usine Produisant Annuellement 2000 Tonnes d'Huile de Palme. *Bull. Inst. Colon. Marseille, Mat. Grasses*, 1945, **29**, No. 7-8, 107-116.

The Cultivation and Harvesting of Sunflowers. By G. E. Blackman. *Agriculture*, 1946, **53**, No. 1, 27-33.

The Cultivation of the Tung Tree in Nyasaland. By C. C. Webster. *Emp. J. Exp. Agric.*, 1946, **14**, No. 53, 18-24.

Soya Beans in Nigeria. By J. K. Mayo. *Trop. Agric., Trin.*, 1945, **22**, No. 12, 226-229.

Soybean or Vegetable Milk. A Resumé and Bibliography. By A. K. Smith and A. C. Beckel. *Chem. Engng. News*, 1946, **24**, No. 1, 54-56.

Essential Oils

Oil of Angelica—Production and Characteristics. By E. Guenther. *Food Industr.*, 1946, **18**, No. 1, 104-106, 218.

Cinnamon Leaf Oil. By S. Krishna *et al.* *J. Sci. Industr. Res. India*, 1946, **4**, No. 8, 464-466.

The Analysis of Lavender Oils. By Y. R. Naves. *Soap*, 1946, **22**, No. 2, 40-43, 79.

Fibres

Effect of Variety, Location and Season on Oil, Protein and Fuzz of Cottonseed and on Fiber Properties of Lint. By O. A. Pope and J. O. Ware. *Tech. Bull. No.* 903, *U.S. Dep. Agric.* Pp. 41, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 10 cents.

Annual Report of the Technological Research Scheme, Indian Central Jute Committee, 1944-45. Pp. 48, 9½ × 6¼. (Calcutta: Indian Central Jute Committee, 1945.)

Measurement of Important Physical Characters of Jute Fibre Strands and their relation to Yarn Quality. By K. R. Sen and C. R. Nodder. *Tech. Res. Mem. No.* 7, *Indian Cent. Jute Comm.* (Calcutta: Central Jute Committee, 1944). Price As. 14.

La Produccion del Yute en la Republica Argentina. Pp. 56, 10½ × 9. (Buenos Aires: Corporacion para la Promocion del Intercambio, S.A., 1944). A monograph on the production of jute in the Argentine prepared by the Armour Research Foundation.

A Small Separator for the Recovery of Milkweed Floss and Seed. Part II. Performance Standardization. By D. H. Hamly. *Canad. J. Res.*, 1945, **23**, No. 6, 383-387.

Report of the Wool Marketing Committee. Pp. 23, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 4*d.* Report of the Committee appointed by the Minister of Agriculture and Fisheries and the Secretary of State for

Scotland to examine the pre-war arrangements for the marketing of wool by producers in Great Britain and changes introduced under wartime control.

Rubber

Observations sur l'Exploitation des Funtumias au Cameroun. *Agron. Trop.*, 1946, **1**, Nos. 1-2, 60-68. Reprinted from *Bull. Soc. Études Camerounaises*, 1944, No. 5, 73-87.

Livestock and Animal Products

Annual Report of the Scottish Marine Biological Association, Millport, Isle of Cumbrae, 1944-45. Pp. 28, $8\frac{1}{2} \times 5\frac{1}{2}$. (Glasgow: Scottish Marine Biological Association, 1945.)

Annual Report of the Veterinary Department, Northern Rhodesia, for 1944. Pp. 16, 13×8. (Lusaka: Government Printer, 1945.) Price 1*s*.

Annual Report of the Department of Veterinary Science and Animal Husbandry, Tanganyika Territory, for 1944. Pp. 20, $9\frac{3}{4} \times 6\frac{3}{4}$. (Dar es Salaam: Government Printer, 1945.) Price Sh. 1/-.

Pasteurization of Milk, Cream and Dairy By-Products. *Publ. No.* 569 (*Revised*), *Dep. Agric. Canada*. Pp. 28, $9\frac{3}{4} \times 6\frac{1}{2}$. (Ottawa: King's Printer, 1945.)

Gas-Packing Dry Whole Milk. By S. T. Coulter and R. Jenness. *Food Industr.*, 1946, **18**, No. 3, 96-99, 212.

Vitamin Retention in Processed Meat. Effect of Storage. By J. F. Feaster, J. M. Jackson, D. A. Greenwood and H. R. Kraybill. *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 1, 87-90.

South African Fish Products. Part XIX. The South African Seal Fishery. By M. M. Black, W. S. Rapson, H. M. Schwartz and N. J. van Rensburg. *J. Soc. Chem. Ind., Lond.*, 1945, **64**, No. 12, 326-331.

Modern Processing of Cod Livers. Expanded Output of Vitamins. *Aust. Food*, 1946, **15**, No. 6, 20, 24.

Hides and Skins and Leather. *Rep. No.* 13, *War Changes in Industry Series, U.S. Tariff Comm.* Pp. 116, 9×6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 25 cents.

FORESTRY

General

Annual Report on the Forests Department, Western Australia, for 1944-45. Pp. 14, 13×8. (Perth: Government Printer, 1945.)

Annual Report on the Woods and Forests Department, South Australia, 1943-44. Pp. 13, 13×8. (Adelaide: Government Printer, 1945.)

Annual Report on the Forest Administration, Nigeria, for the period January 1, 1944, to March 31, 1945. Pp. 47, 13×8. (Lagos: Government Printer, 1945.) Price 4*s*.

Forest Research in India and Burma, 1943-44. Part I. The Forest Research Institute. Pp. 159, $9\frac{1}{2} \times 6\frac{1}{2}$. (Dehra Dun, U.P.: Forest Research Institute, 1945.) Price Rs. 3.

Grasslands and their Afforestation in Ceylon. By C. H. Holmes. *Indian For.*, 1946, **72**, No. 1, 6-11.

Suitable Species for Dry and Desert Areas. By R. L. Badhwar and A. L. Griffith. *Indian For.*, 1946, **72**, No. 2, 64-73. A list of trees, bushes, herbs, shrubs and grasses useful in the afforestation of dry areas.

The Thinning of Plantations. *Forest Operations Series No.* 1, *For. Comm.* Pp. 40, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: H.M. Stationery Office, 1946.) Price 9*d*.

Natural and Artificial Regeneration of Teak in Burma. By C. W. D.

Kermode. *Indian For.*, 1946, **72**, No. 1, 15-21. A paper read at the 6th Silvicultural Conference, Dehra Dun, 1945.

Timber

Timber Seasoning in South Africa. By M. H. Scott. *Bull. No.* 254, *Dep. Agric. Un. S. Afr.* Pp. 40, 9½ × 6. (Pretoria: Government Printer, 1945.) Price 3*d*.

Gums and Resins

La Gomme Arabique dans la Région du Tchad. By G. Venault. *L' Agron. Trop.*, 1946, **1**, Nos. 3-4, 179-181.

Gum *Sterculia urens* as a Thickener in Textile Printing. By V. C. Patwardhan and S. R. Ramachandran. *J. Indian Chem. Soc., Industr. News Ed.*, 1945, **8**, Nos. 1 and 2, 14-17.

A Review of the Fifteen British Patents on Cashew Nut Shell Liquid and Resins. Compiled by H. I. Harvey. *Paint Technol.*, 1945, **10**, No. 119, 289-294; No. 120, 323-325.

Tanning Materials

The Vegetable Tanning Materials of India. Part III—Babul (*Acacia arabica* Willd.). *Indian For. Leafl. No.* 74, 1945. Pp. 21, 9 × 5½. (Dehra Dun, U.P.: The Forest Research Institute, 1945.) Price As. 8.

The Vegetable Tanning Materials of India. Part V—Black Wattle (*Acacia mollissima* Willd.). *Indian For. Leafl. No.* 76, 1945. Pp. 22, 9 × 5½. (Dehra Dun, U.P.: The Forest Research Institute, 1945.) Price As. 8.

IMPERIAL INSTITUTE

CONSULTATIVE COMMITTEE ON INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

QUARTERLY BIBLIOGRAPHY OF INSECTICIDE MATERIALS OF VEGETABLE ORIGIN, NO. 34

(January to March 1946)

Compiled by Miss R. M. Johnson

With the collaboration of the Imperial Institute of Entomology and the Department of Insecticides and Fungicides, Rothamsted Experimental Station.

GENERAL

Ann. Rep. E. Malling Res. Sta., 1944. Raspberries treated with nicotine and Bordeaux mixture for cane blight and one application of lonchocarpus gave sufficient control of the cane beetle, p. 16; rotenone dusts proved ineffective against the apple blossom weevil, p. 28; the black-bodied sawfly easily controlled by derris spray, p. 80; in investigations of the life history of the apple blossom weevil dusting with derris powder under favourable conditions was not effective in reducing the amount of damage, p. 91; nicotine recommended for addition to lime-sulphur spraying for dealing with the hop red spider if the hop fly is present, pp. 126-127; the addition of nicotine to lead arsenate spray advised if maggots of the codling moth have entered the fruitlets, p. 127.

Bionomics and Control of the Nigra Scale, *Saissetia nigra*. By R. H. Smith. *Hilgardia*, 1944, **16**, No. 5, 225-228. (*R.A.E.*, 1945, **33**, A, Pt. 12, 373-374.) Summer oil sprays were superior to preparations of pyrethrum, rotenone and nicotine.

Transpiration through the Cuticle of Insects. By V. B. Wigglesworth. *J. Exp. Biol.*, 1945, **21**, Nos. 3-4, 97-114. (*R.A.E.*, 1946, **34**, A, Pt. 2, 60-61.) In a small test to determine the effect of detergents on the penetration of the cuticle by insecticides, rotenone or nicotine in acetyl ether or polyethylene glycol applied to the backs of nymphs of *Rhodnius prolixus* caused their death in 24 hours; when insecticides applied in medicinal paraffin, the rotenone produced no effect in seven days and the nicotine very little in two days.

External Parasites of Poultry. By R. T. M. Pescott and H. F. Clinton. *J. Dep. Agric. Vict.*, 1945, **43**, Pt. 2, 471-478. Powder containing pyrethrum can be used for dealing with lice, nicotine preparations for ticks.

New Insecticides for Chicken Lice Control. By H. A. Telford. *J. Econ. Ent.*, 1945, **38**, No. 5, 573-576. A number of insecticides tested, including nicotine, sabadilla, derris and pyrethrum.

Biology and Control of Ash Plant Bugs in California. By R. L. Usinger. *J. Econ. Ent.*, 1945, **38**, No. 5, 585-591. Nicotine, rotenone and pyrethrum tested.

Alkanamides as Activators for Pyrethrins and Rotenone-containing Materials. U.S. Pat. No. 2,386,779. *Amer. Chem. Absts.*, 1946, **40**, No. 3, 672.

Additive for Insecticides. U.S. Pat. No. 2,368,195. *Soap*, 1946, **22**, No. 1, 141. Crotonamide an added toxicant in insecticides containing pyrethrins or rotenone.

The Evaluation of Liquefied Gas Aerosol Formulations. By L. D. Goodhue. *Soap*, 1946, **22**, No. 2, 133, 135, 165.

An Extractor for Use with Reduced Pressure. By W. F. Barthel. *Industr. Engng. Chem., Anal. Ed.*, 1945, **17**, No. 1, 53-54. (*R.A.E.*, 1945, **33**, B, Pt. 12, 182.) Of special use in work on the preparation of purified pyrethrin concentrates.

Factors Influencing the Interaction of Insecticidal Mists and Flying Insects. Part I. The Design of a Spray Testing Chamber and some of its Properties. By W. A. L. David. *Bull. Ent. Res.*, 1946, **36**, Pt. 4, 373-393.

Roach Rearing and Testing. By L. J. Bottimer. *Soap*, 1945, **21**, No. 12, 151-157.

Modifications of the Liquid Roach Method. By F. O. Hazard. *Soap*, 1945, **21**, No. 12, 159, 167.

The Cholinesterase of Insect Nerves. By A. G. Richards and L. K. Cutkomp. *J. Cell. Comp. Physiol.*, 1945, **26**, No. 1, 57-61. Not affected by nicotine, pyrethrum, DDT and rotenone.

Investigations of Insecticidal Sprays. By A. B. P. Page, A. Stringer and R. E. Blackith. *Nature*, 1946, **157**, No. 3977, 80-81.

Report on the Analysis of Insecticides and Fungicides. By J. J. T. Graham. *J. Assoc. Offic. Agric. Chem.*, 1945, **28**, 571-575. (*Amer. Chem. Absts.*, 1946, **40**, No. 3, 665.)

ALKALOID-CONTAINING MATERIALS

Tobacco Products, including Nicotine and Nicotine Derivatives

Report on Determination of Nicotine in Insecticides. By C. V. Bowen. *J. Assoc. Offic. Agric. Chem.*, 1945, **28**, 578-585. (*Amer. Chem. Absts.*, 1946, **40**, No. 3, 665.)

Codling-moth Infestation at Different Heights in Apple Trees. By A. M. Woodside. *Bull. No.* 360, *Virginia Agric. Exp. Sta.*, 1944. (*R.A.E.*, 1946, **34**, A, Pt. 1, 4.) Nicotine and lead arsenate controlled the larvae.

The Violet Leaf-rolling Gall Midge Dasyneura (*Perrisia affinis*) Kieffer in Egypt. By M. S. El-Zoheiry. *Bull. Soc. Fouad Ier. Ent., Egypt*, 1944, **28**, 113-118. (*R.A.E.*, 1946, **34**, A, Pt. 1, 18.) Plants sprayed in early spring with nicotine sulphate remained free all the year.

Control of Cabbage Pests. Outstanding Results with DDT and 666 Dusts. By G. Pasfield. *Agric. Gaz. N.S.W.*, 1945, **56**, Pt. 2, 489-492. A lead arsenate-nicotine dust was inefficient in protecting cabbages from damage; DDT and 666 dusts gave outstandingly successful results.

6th Quart. Rep. W. Afr. Cacao Res. Inst., Oct.-Dec., 1945. Refers to the use of nicotine sulphate in the routine spraying against pests of cacao: doubtful if nicotine successful against *Distantiella theobroma*.

The Tomato Mite (*Phyllocoptes lycopersici*). *Agric. Gaz. N.S.W.*, 1945, **56**, Pt. 12, 551-552. Nicotine sulphate included in the composite spray for control.

The Insect Pests of Tomatoes. By L. W. Miller. *Tasm. Agric. J.*, 1945, **16**, No. 4, 144-148. Nicotine dust gives control of the potato moth (*Gnorimoschema operculella* and of white flies (*Trialeurodes vaporiariorum*).

Undersogelser over Aebleviklerens Biologi i Danmark. By P. Bovien and N. Bolwig. *Tidsskr. Planteavl*, 1944, **49**, 144-157. (*R.A.E.*, 1946, **34**, A, Pt. 1, 8.) In investigations on the biology of the codling moth in Denmark it was considered that nicotine might be of use in controlling the pest if applied against migrating larvae.

La Nicotine, Caractères, Préparation, Emplois. By M. Gordon. *Chimie et Industrie*, 1945, **53**, No. 1, 27-32.

INSECTICIDE MATERIALS CONTAINING ROTENONE AND ALLIED SUBSTANCES

General

Field Trials of DDT against the Raspberry Beetle (*Byturus tomentosus* Fabr.). By H. Shaw. *J. Pomol.*, 1945, **21**, Nos. 1-4, 140-145. Trials were made to determine whether DDT could be substituted for rotenone: it compared favourably with lonchocarpus both in degree of control obtained and persistence of effect.

Carpenter Ant Control in Oregon. By R. L. Furniss. *Circ. No.* 158, *Oregon Agric. Exp. Sta.*, 1944. (*R.A.E.*, 1946, **34**, A, Pt. 1, 27-28.) Rotenone dust effective.

The Pear Thrips in California. By S. F. Bailey. *Bull. No.* 687, *Calif. Agric. Exp. Sta.*, 1944. (*R.A.E.*, 1946, **34**, A, Pt. 1, 24.) Rotenone sprays (especially those to which pyrethrum had been added) gave the best results.

Laboratory Studies with Rotenone Oil in Sprays to Control the California Red Scale. By D. L. Lindgren, J. P. La Due and R. C. Dickson. *J. Econ. Ent.*, 1945, **38**, No. 5, 567-572.

DDT and Rotenone Used in Oil to Control the California Red Scale. By W. Ebeling. *J. Econ. Ent.*, 1945, **38**, No. 5, 556-563.

Control of Housefly Breeding in Partly Digested Sewage Sludge. By T. A. Olson and R. G. Dahms. *J. Econ. Ent.*, 1945, **38**, No. 5, 602-604. Rotenone emulsion did not control the breeding.

Dusting for Cattle Lice. By C. Lyle and R. G. Strong. *J. Econ. Ent.*, 1945, **38**, No. 5, 611-612. Rotenone dust somewhat more effective than DDT.

Controlling Cattle Ticks. By R. L. Squibb. *Agric. in Americas*, 1946, **6**, No. 1, 12-14. Spray solution made of rotenone and DDT used.

Cattle Sprayer for the Tropics. *Science News*, 1945, **102**, August 17. (*Soap*, 1945, **21**, No. 12, 86.) Fine spray containing DDT and rotenone against cattle tick seemed satisfactory.

Insecticide Liquid. U.S. Pat. No. 2,378,309. *Soap*, 1946, **22**, No. 1, 78. A high-boiling liquid resulting from the reaction of ethylene and/or acetylene with benzene is a desirable carrier of insecticides, and rotenone in particular.

A Review of the Insecticidal Uses of Rotenone and Rotenoids from Derris, Lonchocarpus (Cube and Timbo) Tephrosia and Related Plants. Part IX. By R. C. Roark. *U.S. Dep. Agric. Bur. Entomol.*, E-652, April 1945.

A Review of the Insecticidal Uses of Rotenone and Rotenoids from Derris, Lonchocarpus (Cube and Timbo), Tephrosia and Related Plants. Part X. Siphonaptera. By R. C. Roark. *U.S. Dep. Agric. Bur. Entomol.*, E-654, April 1945.

A Review of the Insecticidal Uses of Rotenone and Rotenoids from Derris, Lonchocarpus (Cube and Timbo), Tephrosia and Related Plants. Part XI. Acarina. By R. C. Roark. *U.S. Dep. Agric. Bur. Entomol.*; E-655, May 1945.

A List of Arthropods, arranged according to Order, Family and Genus, and their Susceptibility to Rotenone and the Rotenoids. By R. C. Roark. *U.S. Dep. Agric. Bur. Entomol.* E-656, 1945.

Conférence de la Roténone. *Agron. Trop.*, 1946, **1**, Nos. 1-2, 78-79. Notes on a conference held on the initiative of the French Ministry for the Colonies to consider the market for rotenone.

Rotenone [in Peru]. *Chem. and Indust.*, 1946, March 23, No. 12, 136. Peru to double its pre-war output of rotenone.

Insecticide Co-Solvent. U.S. Pat. No. 2,368,709. *Soap*, 1946, **22**, No. 2, 151. Chlorination of products such as cashew nut shell liquid, marking nut-shell liquid and Japanese lac can be used as co-solvent for rotenone extracts.

Derris

Mineral Deficiencies in *Derris elliptica*. By R. H. Moore. *Bull. No.* 43, *Puerto Rico Exp. Sta., U.S. Dep. Agric.*

Om Derris og nogle Forsøg med Derrispraeparater til Bekaempelse af Skadedyr. By P. Bovien and C. Stapel. *Tidsskr. Planteavl*, 1940, **45**, 39-83. (*R.A.E.*, 1945, **33**, A, Pt. 12, 381.) Derris and some experiments with preparations of it for the control of pests.

Iets over de Bestrijding van de Bessenblad-wesp (*Pteronus ribesii* Scop.). By J. G. ten Houten. *Tijdschr. PlZiekt.*, 1940, **46**, No. 4, 146-150. (*R.A.E.*, 1946, **34**, A, Pt. 2, 59.) Derris spray or dust gave control on gooseberries in Holland.

Afprovning af kemiske Bekaempelsesmidler med Planteygdomme og Skadedyr. I. By C. Stapel and H. I. Petersen. *Tidsskr. Planteavl*, 1944, **48**, 631-654. (*R.A.E.*, 1946, **34**, A, Pt. 1, 7.) Derris among the products used in tests of chemical control measures against diseases and pests.

Cube

Field Trials of DDT against the Raspberry Beetle *Byturus tomentosus*. By H. Shaw. *J. Pomol. Hort. Sci.*, 1945, **21**, Nos. 1-4, 140-145. (*Exp. Sta. Rec.*, 1946, **94**, No. 2, 237.) DDT is compared with Lonchocarpus.

PYRETHRIN-CONTAINING MATERIALS

A New Preparation for the Control of Agricultural Pests. *Social Soc. Techn. Tashkent*, 1939, **7**, No. 11-12, 193. (*R.A.E.*, 1946, **34**, A, Pt. 2, 49.) Pyrethrum spray gave some control of *Rhynchites auratus ferganensis* attacking apricots.

Some Factors Affecting the Insecticidal Action of Pyrethrum Extracts on the Beet Leafhopper. By F. H. Harries, J. D. DeCoursey and R. N. Hofmaster. *J. Agric. Res.*, 1945, **71**, No. 12, 553-565. Effects of

temperature and humidity on the insecticidal action of pyrethrum extracts against *Eutettix tenellus* were studied.

Crickets in Bakeries. By F. Burke. *Food*, 1946, **15**, No. 173, 37. Bait of sodium fluoride, molasses and pyrethrum effective.

Spray-killing of Mosquitoes in Houses. A Contribution to Malaria Control on the Gold Coast. By L. G. Eddey. *Trans. Roy. Soc. Trop. Med. Hyg.*, 1944, **38**, No. 3, 167-188. Pyrethrum aerosol was shown to be the most desirable insecticide.

An Experiment in the Prophylaxis of Sandfly Fever through the Control of Sandflies. By E. N. Pavlovskii, A. V. Gutzevich and P. O. Perfil'ev. *Trav. Acad. Milit. Méd. Kiroff Armée Rouge*, 1937, **8**, 23-113. (*R.A.E.*, 1945, **33**, B, Pt. 12, 182-183.) Pyrethrum powder and pyrethrum candles effective in control of sandflies.

The Effect of Fly Food on Resistance to Insecticides containing DDT or Pyrethrum. By E. R. McGovran and W. A. Gersdorff. *Soap*, 1945, **21**, No. 12, 165, 169.

Conclusions pratiques à tirer d'une Expérience d'Épouillage par Poudrage Insecticide faite à Maison-Carrée et l'Arba (Algérie). By E. Sergent and M. Béguet. *Arch. Inst. Pasteur Algérie*, 1944, **22**, No. 2, 109-112. (*R.A.E.*, 1945, **33**, B, Pt. 12, 194.) MYL (which contains pyrethrins) and DDT effective.

Observations on Blood-sucking Diptera in the Far East. By A. V. Gutzevich. *Trav. Acad. Milit. Méd. Kiroff Armée Rouge*, 1937, **8**, 151-169. (*R.A.E.*, 1945, **33**, B, Pt. 12, 185.) Protection obtained by burning a pyrethrum smoke-candle.

Neuropathology in Insects. By A. G. Richards and L. K. Cutkomp. *J. New York Ent. Soc.*, 1945, **53**, 313-355. Analysis of the action of pyrethrum is given in detail: other compounds more briefly, including repellents.

Basis for Pyrethrum Extract Report Denied by Kenya Farmers' Association. *Soap*, 1945, **21**, No. 12, 189. Report that American interests were to set up pyrethrum extract factories in Kenya denied.

Purification of Pyrethrum. U.S. Pat. No. 2,372,183. *Soap*, 1946, **22**, No. 1, 141. Extraction of a petroleum hydrocarbon solution of pyrethrum by a nitroalkane, purification of the resulting nitroalkane solution by passing it through a column of activated carbon and removal of the solvent to leave a residue high in pyrethrins.

Pyrethrum Health Report. *Soap*, 1946, **22**, No. 1, 145. Extract from a report by the Senior Medical Officer of the Rift Valley Province, Kenya.

Ann. Rep. Dep. Agric. Ceylon, 1943, p. 7. Refers to experiments in the cultivation of pyrethrum.

OTHER INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

The Structure of Affinin, the Insecticidal Amide from *Erigeron affinis* D.C. By F. Acree, M. Jacobson and H. L. Haller. *J. Org. Chem.*, 1945, **10**, 449-451.

New Vegetable Poisons against the Web Mite. *Social Sci. Techn. Tashkent*, 1939, **7**, No. 11-12, 197. (*R.A.E.*, 1946, **34**, A, Pt. 2, 48-49.) Infusions of *Achillea micrantha*, *Convolvulus sepium* and *Hyoscyamus niger* gave good control of this pest on cotton: *A. micrantha* and *A. millefolium* also gave a measure of control, and a solution of sophocarpin (an alkaloid from *Ammothamnus lehmanni*) also fairly effective.

Protection des Cultures Contre les Acridiens par un Extrait de Mélia. By E. Sergent. *Arch. Inst. Pasteur Algérie*, 1944, **22**, No. 3, 251-254. (*R.A.E.*, 1946, **34**, A, Pt., 1, 11.) Extracts of *Melia azedarach* used as a repellent against locusts.

The Effect of Chemical Irritants on the Ticks *Ornithodorus papillipes*. By I. A. Moskvin. *Trav. Acad. Milit. Méd. Kiroff Armée Rouge*, 1939, **18**,

59-78. (*R.A.E.*, 1945, **33**, B, Pt. 12, 198-199.) Repellents which proved most satisfactory were turpentine, an infusion of the leaves of *Mentha piperita* and *M. crispa*, wood tar, and Malinins mixture (which contains among other ingredients cinnamon oil and pyrethrum).

Science and Technology in China's Far South-East. By J. Needham. *Nature*, 1946, **157**, No. 3981, 175-177. Refers to the value of *Millettia pachycarpa*, *Tripterygium exesum* and *Pachyrhyzus erosus*.

Insecticide. U.S. Pat. No. 2,388,393. *Soap*, 1946, **22**, No. 1, 69. A liquid insecticide extractive comprising a mixture of *Pycnothymus rigidus* and an organic solvent.

Forsøg med Bekaempelse af Blommehvepsen (*Hoplocampa fulvicornis*.) By P. Bovien and C. Stapel. *Tidsskr. Planteavl*, 1940, **44**, 699-730. (*R.A.E.*, 1945, **33**, A, Pt. 12, 380.) Quassia sprays were effective and superior to nicotine in experiments on the control of the plum sawfly.

Besprutningsförsok mot Plommonstekeln, *Hoplocampa minuta* Chr. By O. Ahlberg. *Medd. Växtskyddanst.*, 1940, No. 32. (*R.A.E.*, 1946, **34**, A, Pt. 2, 37.) Of the various sprays tested against the plum sawfly quassia was the most effective.

The Principal Alkaloids of Sabadilla Seed and their Toxicity to *Musca domestica*. By M. Ikawa, R. J. Dicke, T. C. Allen and K. P. Link. *J. Biol. Chem.*, 1945, **159**, No. 2, 517-524. (*Exp. Sta. Rec.*, 1946, **94**, No. 2, 223-224.)

DDT and Other Insecticides to Control the Saratoga Spittle Insect on Jack Pine. By R. F. Anderson. *J. Econ. Ent.*, 1945, **38**, No. 5, 564-566. Among the insecticides tested was sabadilla, a mixture of which, with hydrated lime and used as a dust, was very toxic when freshly applied, but did not retain its toxicity when exposed on the trees.

Plants of Possible Insecticidal Value. By N. E. McIndoo. *U.S. Dep. Agric. Bur. Entomol.*, E-661, May 1945.

MINERAL RESOURCES

ARTICLE

THE RELATIONSHIP OF THE GEOLOGICAL SURVEY TO THE MINING INDUSTRY OF MALAYA[1]

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British Malaya is a peninsula extending southwards from the southernmost boundary of Siam and it is more or less equal in size to England, having a total area of 51,076 sq. miles. West of it lie the Straits of Malacca, separating it from the large island of Sumatra, while the east coast is washed by the China Sea. The island of Penang is situated in the north, off the west coast, and the island of Singapore is in the south, at the toe of the peninsula. Naming the States from north to south, Malaya includes Kedah and Perlis, Penang, Province Wellesley, Perak, Kelantan, Trengganu, Pahang, Selangor, Negri Sembilan, Malacca, Johore and Singapore.

Malaya has a tropical climate with heavy rainfall. Certain parts have been developed by mining and agriculture, and there roads and railways have been built, but it is a fact not appreciated even by many who have spent all their lives in the country that more than three-quarters of the Peninsula is still covered with jungle and is uninhabited. Much of the unknown part is mountainous. The positions and heights of the chief mountains have been surveyed by the Trigonometrical Branch of the Surveys Department and a considerable part of the country has been mapped by the Topographical Branch.

The highest mountains of Malaya are over 7,000 ft. and there are many peaks more than 6,000 ft. high. The country is well watered, and before the British came in, less than one hundred years ago, to build roads and railways, rivers provided the chief means of access inland. Much of the coastline is fringed by broad plains, more or less at sea-level, built by the rivers depositing their loads of sand and silt at their mouths, and so continually building the plains further and further out to sea. We geologists often use the rivers for our journeys. There is little geological information to be gathered where they pass through the coastal plains, and only small craft can be used up-river where rapids become frequent. Here the geologist and his coolies have to do a lot of wading, pulling

[1] Lecture delivered on February 28, 1946, at the Imperial Institute.

their dug-outs over the rocks. So long as they can progress a few miles in a day, this is the best way of getting stores inland, but eventually a stage is reached where they have to abandon this method of transport. When the geologist has reached the area he wants to examine, he makes a depot by putting most of his stores high up in a tree, beyond the reach of marauding elephants, and with a dozen carriers, Malays or aborigines, he makes side excursions on foot, taking canvas sheets for shelters and enough food for six or eight days, after which he plans to be back at the depot again to renew stores and start exploring in a new direction. Probably he intends to return to civilisation by a different route, examining new country as he goes, so he crosses the watershed to the head-waters of another river, which he follows downstream, and when the stream is big enough he and his coolies build a bamboo raft to carry them down-river. He stops for a few nights at selected places to climb the neighbouring mountains and examine the country in detail.

Under my predecessor, Mr. J. B. Scrivenor, the Geological Survey Department made a reconnaissance geological survey of the Peninsula and reports were published on part of Pahang, on the Kinta Tinfield, on Perak, Selangor, Negri Sembilan, Kedah and Perlis, Johore, the Langkawi Islands (west of the Perlis coast), Singapore, Malacca, and also short accounts on Trengganu and Kelantan. A summary of what was then known of the geology and mineral deposits of Malaya is contained in Mr. Scrivenor's two books, *The Geology of Malayan Ore-deposits* and *The Geology of Malaya.* Latterly, we have been engaged on detailed surveys, and reports on three areas in Perak and Pahang have been published, with four geological maps in colour, based on topographical sheets of scale 1 in. to 1 mile, covering about 1,100 sq. miles. Within three years from now it is expected to have reports ready for publication on six additional areas, illustrated by a further twenty maps of the same type, covering about 6,000 sq. miles. But for the Japanese invasion these would already have been published.

The Mining Industry of Malaya

Tin

Any description of the Mining Industry of Malaya must be devoted mainly to tin mining. Exports of metallic tin from the Federated Malay States, not counting those from the Unfederated States, from the year 1900 to the time of the Japanese invasion at the end of 1941, amounted to more than two million tons, representing nearly 40 per cent. of the world's output.

In 1939, while restriction was in force to keep unwanted supplies off the market, the tinfields of the Federated Malay States were allowed to produce 52,232 tons of metallic tin, 28·3 per cent. of the world's output. In 1940, when it was necessary to get large stocks, and restriction was in some measure abated, the production

rose to 81,332 tons, amounting to 34·3 per cent. of the world's output; in the first six months of 1941, 41,585 tons were produced.

While the Japanese were in occupation of Malaya, from February, 1942, to August, 1945, they worked some of the tin mines, and information collected from the Japanese mining officials now interned in Singapore indicates that they produced between 12,000 and 15,000 tons of metallic tin. Thus, in 3½ years, their total output amounted to what was being produced every two months during 1940 and 1941.

The Mitsui Mining Company, with its head office in Ipoh, Perak, controlled 25 dredges near Batu Gajah, Malim Nawar, Kampar and Bidor, and four hydraulic mines, but eight of these dredges were never operated. Another Japanese company also worked mines at Gopeng, Malim Nawar and Kampar. Still another company had three dredges working in North Selangor at Kalumpang and Rasa, beginning in September, 1943. The Ishihara Sangyo Koshi, a company that had long owned iron mines in Malaya, was responsible for getting eight dredges going in South Selangor, opening up in April, 1943, but they experienced great difficulty in keeping them going and they mined only 440 tons. The same company had one dredge working in South Johore from October 1944 to July 1945 to produce 128 tons of tin. The total production of metallic tin from the State of Pahang during the Japanese occupation was about 200 tons.

Other Minerals

Coal was first mined in 1915, and from that year until the end of 1941 about ten million tons were won, all for local use. The Mitsubishi Mining Company had charge of the Batu Arang Colliery (in the Tertiary of Selangor) during the Japanese occupation, from February 1942 until August 1945, and it is said that they mined 30,000 tons a month.

In the last 50 years 800,000 oz., of *gold* have been mined.

Iron ore, most of it high grade, was mined in Malaya by the Japanese for about 20 years before 1941 with gradually increasing outputs, and during their last six years of operations they were exporting to Japan at the rate of more than 1½ million tons a year. They did not work the iron mines at all during the years they occupied the country.

The Japanese began to mine *bauxite* (aluminium ore) in Johore in 1936, and in 1938 exports to Japan were more than 55,000 tons. According to figures supplied in December 1945 by the Senior Engineer of the Ishihara Sangyo Koshi interned in Singapore, 370,000 tons of bauxite were shipped during the 3½ years of Japanese control in Malaya, and this included 120,000 tons from a deposit in Malacca that had not been touched prior to 1942; but we know that, from causes outside their control, much of that 370,000 tons did not reach Japan.

Exports to Japan of *manganese ore* from two mines in Kelantan and Trengganu for the six years before the invasion were about 30,000 tons a year.

The *tungsten ores, wolfram* and *scheelite,* were produced at the rate of hundreds of tons for many years, and while the famous scheelite mine at Kramat Pulai was in production the hundreds became thousands.

Malaya also possesses extensive deposits of *kaolin* (*china-clay*), which, however, is mined only in quantity sufficient for local needs.

Ilmenite is a by-product of alluvial tin mining in North Malaya, and there are about 300,000 tons of it collected in dumps in the tinfields ; only a few thousand tons have been exported each year. It is used in the manufacture of the important white pigment known as titanium-white.

Thousands of tons of *zircon* also could be obtained from dumps in the tinfields, and a limited quantity of *monazite* would also be available.

It is unlikely that *mineral oil* will ever be found in Malaya in quantities worth producing.

It is not possible to give the exact value of the two million tons of tin produced since 1900, but it was somewhere between £400,000,000 and £500,000,000, whereas the value of all the other minerals mined during the same period might have been as much as £50,000,000, not more. Clearly tin mining is the main mining industry of Malaya. Moreover, when tin mining is spoken of in this paper, except when lode mining is specifically referred to, mining by alluvial methods is implied, because by far the greater part of Malaya's tin production—more than 95 per cent.—is from loose deposits of sand and clay. Nevertheless, it is to be noted that one of the most important lode tin mines in the world, that operated by the Pahang Consolidated Company, Limited, is situated in Malaya.

Geological Structure and Tin Deposits

A geological map of British Malaya shows that the different rock formations occur as elongated outcrops, roughly parallel with one another and with the length of the Peninsula. This arrangement came about as a result of folding movements which crumpled rock layers into a succession of parallel waves that were later eaten into by erosion. Granite masses occupying anticlinal cores have been laid bare, flanked by the upturned eroded edges of the various metamorphosed strata that formerly overlay them.

Some parts of these granite masses and the metamorphosed rocks near them contained veins of tin ore, the erosion of which has led to the accumulation of alluvial tin deposits. The fact that the veins were all located near the periphery of a granite intrusion

determined that alluvial deposits also are sited near granite contacts, and this does indeed apply to all the principal tinfields of Malaya.

Bedrock under the Kinta tinfield and the Kuala Lumpur tinfield consists mainly of crystalline limestone, with pitted surfaces that formed very efficient traps for holding back the heavy grains of tin ore as they were borne over them by streams. In fact, the surface-irregularities in these plains behaved like riffles on the surface of great concentration-tables. Deep solution-troughs are located along lines of contact of limestone with less soluble rocks, such as granite or schist or quartzite, and, where the contact-rocks were mineralised, such troughs contain the richest deposits of detrital tin ore.

Modes of Occurrence of Tin Ore

The only tin ore of any importance in Malaya is the mineral cassiterite, tin dioxide, SnO_2. Its colour in Malaya commonly is brown-black, of a distinctly lighter shade than the cassiterite of Cornwall. Sometimes, indeed, it is pale brown, and occasionally a white variety is found. Rarely one finds specimens of green or red cassiterite. Sometimes it is found as large crystals, but usually it occurs as sand, in various grain-sizes, from pieces the size of a pea down to the finest flour. It is a heavy, hard mineral that can withstand a great deal of abrasion.

Tin ore usually occurs in layers of detrital gravel with quartz pebbles and white clay, underlying other alluvial beds which may or may not also contain tin ore. Tin ore is also found in solid rock, in stringers and veins, in granite, schist, limestone, and quartzite. It is repeated that the richest deposits are found near the contact of granite with limestone and other rocks. Having found the tin deposits, the problem that confronts miners is to find the best method of excavating them and of separating tin ore from the impurities which constitute more than 99 per cent. of their bulk. When they have isolated the tin ore, they sell it to the smelting companies, who produce metallic tin from it.

Mining Methods used in Malaya

Tin mining methods now practised in Malaya may be classified as follows:

- Dredging
- Gravel-pump mining
- Hydraulicking
  - (*a*) using water under natural head
  - (*b*) with water not under pressure
- Open-cast mining
  - (*a*) with trucks and rails
  - (*b*) by hand labour only
- Lode mining

Dredging

The bucket dredge used in Malaya is of the endless chain type. A continuous chain of manganese steel buckets is carried on rollers resting on a steel ladder, the upper end of which is pivoted on a superstructure some 25 to 30 ft. above the deck of the pontoon. The lower end of the ladder is suspended by cables which pass to a winch over a top and bottom set of sheaves, so that it may be raised or lowered as required to bring the buckets to dig into the working face.

The ground is excavated and delivered into the hopper or drop chute, whence it is fed to revolving or shaking screens. Jets of water break it up, and anything unable to pass through the screens travels into the "stone chute" and is rejected. Tin-bearing material passes through the screens into a distributor, which feeds it, with added water, either into jigs or into a series of sluices in which the tin ore is concentrated.

The dredge floats in a pond dug by itself as it progresses. Water flows in at the front and escapes at the back carrying slimes with it. Dams are built behind to retain tailings.

Dredging has proved most successful in Malaya, and much ground of low value which would otherwise have been left untouched is being worked profitably. Where the bedrock is soft, the whole of the tin-bearing ground can be excavated, but losses occur when the bedrock consists of limestone pinnacles, because the richest material is contained in inaccessible channels and hollows. In 1941 there were 123 dredges operating in Malaya with a total designed dredging capacity of about 22 million cu. yds. a month. In 1940 they produced ore containing 42,204 tons of metallic tin, more than half of Malaya's total output. In the first six months of 1941 they produced 21,297 tons.

Gravel-pump Mining

The method of mining most popular with the present-day Chinese in Malaya is by gravel-pump. Usually a pressure-pump is used to feed monitors which throw jets of water powerful enough to cut and disintegrate the ground. The broken material is washed along a channel in the bottom of the mine to a sump, whence the mixture of sand, clay and water is lifted by a gravel-pump to the head of a *palong* or flume, which may be anything from 40 ft. to 120 ft. above the sump.

The heavy tin ore is held up at numerous points along the length of the *palong* by stops, or wooden bars, placed one on top of the other at intervals across the bottom of the flume. Most of the lighter sand and clay passes out of the *palong* with the stream of water, to be deposited in the allotted dumping space. After several days, when the stops in the *palong* have been raised to a certain height, the supply of water and sand from the gravel-pump is shut off, and the mixture of tin ore and sand in the flume is

further concentrated by raking it against a flow of water. The concentrates from this operation, containing about 50 to 60 per cent. of tin dioxide, are placed in wooden buckets and taken to the washing sheds for final treatment.

Hydraulicking using Water under Natural Head

In this method a dam is contructed in a stream bed at such a height in the hills as may be necessary to produce the required pressure at the level of the mine. The impounded water is then conveyed either by pipes direct to the mine, or in a ditch-line to a pressure-box whence it flows down pipes. There it emerges under pressure from a monitor which resembles the nozzle of a fire-hose. The jet is directed at the face of the mine, cuts it down, and the resulting mixture flows down a ditch or a wooden sluice in which the tin ore is partly concentrated by the flow of water, and women are employed to continue the concentration by using a round, shallow, wooden dish called a *dulang*. In cases where the ground to be worked lies below the drainage level of the district, or lacks sufficient grade, elevators are used to raise the disintegrated ground and water to a higher level from which the necessary slope can be given to the sluice. A jet of water under pressure sucks in water and gravel and forces them up a pipe, delivering them at the sluice-head.

Hydraulicking with Water not under Pressure

Hydraulicking with water not under pressure is known locally as *lampan* mining. Water is led along a ditch at the foot of the mine face, which is then cut into steps by men who work downwards, starting from the top. When the bottom of the face is reached they work upwards, cutting the steps away. The ground so removed falls into the ditch, where much of the sand is washed away by the water and a concentrate remains from which the tin ore is extracted. A variation of the method is to lead the water over the top of the face using it as an agent for breaking up the ground.

Open-cast Mines with Trucks and Rails

Some enormous excavations have been made by mining with trucks and rails, as in the Sungei Besi District of Selangor. In 1938 the Hong Fatt Mine had an area at the surface of 116 acres, and at the bottom of the mine, which is 310 ft. below road level, 3¾ acres. From this huge hole, 30 million cu. yds. of earth had been removed. Four electric navvies were used on the upper benches, but hand labour was employed at the mine bottom. The broken ground was loaded into small trucks and hauled up to puddlers, whence it was passed over sluices where the ore was concentrated.

Open-cast Mining by Hand Labour only

Open-cast mining by hand labour is a purely Chinese method.

The ground is put into flat baskets which are hung at either end of a carrying stick carried on the shoulders of the coolies. They climb up gently-inclined, notched logs that serve as ladders from the floor to the top of the mine.

The *karang*, or " pay-dirt," is first puddled by hand in a square pit and then carried to coffin-shaped cleaning sluices. Water is let into the head, and the *karang* is shovelled in by a coolie at the side. Another coolie stands in the water raking the concentrates with a *changkol*, a kind of hoe, while other labourers, men or women, dig out the waste material and carry it away.

Until recently, open-cast mines were de-watered either by a primitive wooden chain-pump or by portable steam engine or oil engine operating a centrifugal pump, but lately electricity has been replacing other forms of power. Electric power is supplied in Perak by the Perak Hydro-Electric Power Company, Limited, and, in Selangor, by the Government-owned Kuala Lumpur Power Station.

Lode Mining

The mines operated by the Pahang Consolidated Company, Limited, combine to form one of the biggest producers of tin ore in the world. They are situated at Sungei Lembing in the Kuantan district in north-east Pahang, near a small outcrop of granite. The lodes are located within an area approximately 6 miles north and south by 2½ miles east and west, in hilly country ranging from 120 ft. to 1,150 ft. above sea-level. Prospecting has located no important alluvial deposits, although, as is usual, the lodes were discovered originally by prospectors following up alluvial ore in the creeks.

The tin-bearing lodes radiate from the eastern side of a granite intrusion into the overlying shale, schist, quartzite and sandstone; some occur also in the granite itself. They strike east and west, and they dip either north or south. The pitch of the ore-shoots in the lodes is roughly parallel to the contact of the granite with the schist.

The ore-bodies have no well-defined walls, and consist generally of narrow fissures filled with mineralised quartz, with varying widths of impregnated country rock on either side. In some cases the ore-body is a stockwork. In addition to cassiterite, the lodes carry iron pyrites, zinc blende, copper pyrites and arsenical pyrites. No wolfram occurs in the lodes and tourmaline is uncommon.

Owing to the hilly nature of the terrain much mining has been possible above adit level, and the outcrops of most lodes have been worked by open-cut. Several lodes have been worked below adit level to depths of about 500 ft., and, in the Willinks and Myah Mines, a series of ore-bodies has been worked to a depth of 1,200 ft. below adit and for nearly two miles along their strike. These same

lodes have been mined to 1,000 ft. above adit level, so their vertical extent has now been proved as 2,200 ft.

The Willinks and Myah Mines have been developed through five vertical shafts, with upper levels 60 ft. apart and lower levels 100 ft. apart. The lodes vary in width from a few inches to as much as 60 ft., individual ore-bodies tending to a lenticular shape and following one another *en échelon.* The more usual stoping width is from 4 to 8 ft.

It has already been emphasised that tin mining is the major mining industry in Malaya, and it is not intended in this short paper to describe in detail the mining of coal, gold, iron ore, bauxite, tungsten ore and manganese ore. The veins of tin ore, gold, tungsten ore and some of Malaya's iron ore deposits originated with the granite, so it is clear that a study of that rock and of the rocks associated with it is of great importance to the mining industry. Deposits of bauxite and manganese ore and some of the iron ore were accumulated by agencies of weathering and have no special association with granite.

The Geological Survey Department

Having given a short description of the mineral wealth of Malaya, and an account of mining methods, it remains to explain the responsibilities of the Geological Survey Department in this country which, before the war, was the most important mineral producer in the Colonial Empire.

The first geological surveys undertaken by Government were directed by Mr. J. B. Scrivenor, who began mapping in the year 1903. He retired in 1931, and the work done by him and the few geologists who helped him in those first three decades has been described by Sir Lewis Fermor in his *Report on the Mining Industry of Malaya* as "almost heroic." Under Mr. Scrivenor's direction a reconnaissance geological map of the Malay Peninsula was published.

The senior staff of the Department now consists of seven geologists and two chemists, and it may be mentioned here that eight of the nine were in the hands of the Japanese, in Singapore and Siam, for 3½ years, and that all survived. The other member, a geologist, was ordered to leave before the capitulation because he belonged to the Volunteer Air Force, and he joined the Army that was to have re-taken Malaya. He is now a Staff Officer in one of the Divisions in Malaya, and it is he, Lieut.-Col. F. W. Roe, who has supplied the information in this paper about Japanese mining during the occupation. He also gives the good news that, although there have been serious losses, yet most of the Geological Survey records are safe, through the efforts of some of the subordinate staff led by the Chief Clerk and helped in some measure by the goodwill of a Japanese geologist.

Detailed Geological Mapping

The main object of the Department, as now constituted, is to prepare and publish detailed maps of those areas indicated by the reconnaissance survey as most likely to afford mineral deposits.

It has been suggested that the best method of prospecting the hill country in Malaya is to let loose a swarm of Chinese giving them a free hand to mine. They would search the jungle for signs of tin ore. They would *lampan* the slopes, and, in so doing, would uncover rich deposits and discover payable lodes. There is no doubt of the energy and enterprise of the Chinese. Their endurance and willingness to live in very uncomfortable conditions have been a great asset to Malaya, and many important tin deposits have been found by them in the past. Unfortunately, however, it is not possible now to allow wholesale hydraulicking in hill country because of the damage that would be done by sand and slimes pouring down the river valleys to spread over the plains. Yet it is certain that the great unexplored areas should be examined—more than three-quarters of the Peninsula is still under virgin jungle—and the work must be done by geologists.

They cannot use the easiest way of looking for mineral deposits by stripping the cover of soil and vegetation off the hill-slopes, and, in our hot damp climate, with its intense rotting effect on all rocks, this cover is unbelievably thick to those unaccustomed to the wet tropics. In journeys across inland areas, except in streams, one seldom sees an exposure of fresh rock, and it is true to say that only a geologist with experience in the country can interpret correctly the evidence available—the soil and the fragments of weathered rock in it. To supplement this evidence he has to search the mountain slopes for rare exposures left by landslides and waterfalls.

In the past little deep prospecting has been carried out by the Geological Survey, although, when the Japanese invaded Malaya, two areas were actually being drilled under the direction of the Department, one for deep alluvial tin-deposits, the other for coal. In future, any areas found by a geologist during the course of his detailed mapping that he considers need testing will be prospected.

The Systematic Examination of Mines

Besides this programme of searching for new deposits by making detailed geological surveys, valuable geological information is yielded by a continual study of working mines, which also helps to ensure that known mineral deposits are mined to the best advantage.

Lode Mines.—It has been said that the length of underground workings at the Pahang Consolidated Company's Mine amounts to more than 200 miles. If it had been possible in the past for geologists to have studied these in detail, a great wealth of information about tin-lodes in that part of Malaya would have been accumulated. Mr. F. H. Fitch, of the Geological Survey, had made a beginning with

this study in 1939, and, though his work has not progressed far, it will be published in due course. When mining operations are resumed, and after more geological information has been collected, some of the puzzles at the mine will be solved, and geologists will have helped to develop production there to the best advantage. Moreover, facts will emerge to help to locate payable lodes elsewhere.

The published results of Dr. J. A. Richardson's work in the Raub district of Pahang give a clear picture of the mode of occurrence of the gold-bearing quartz-veins at the Raub Australian Gold Mine and enable the following theory to be put forward.

All the ore-bodies and ore-shoots so far mined in the eastern lode-channel appear to be contained in one narrow zone of major mineralisation, aligned north and south, which, at the time of mineralisation had an average dip of 70° towards E.N.E. and pitched approximately 15° towards N.N.W. A large number of post-mineralisation faults across the strike, however, sliced the country into slabs which have been shoved laterally eastwards as one follows the lode from south to north across the faults, and so have given the lode-occurrences a general north and south direction, whereas originally they lay N.N.W. by S.S.E. The lateral displacement by faulting has long been realised at the mine and the method of finding the faulted lodes by crosscutting was known, but Dr. Richardson's recent study of slickensides on the fault-planes shows that there has also been a vertical component equal in amount to the lateral shift, the downthrow being towards the south.

With this new discovery, it is clear that the possibility of finding a northerly extension of mineralisation in the eastern lode-channel, beyond the limits of present mining, depends on whether the effect of the northerly downward pitch has exceeded the effect of the northerly upthrow by faulting. If the influence of the northerly pitch has been the smaller of the two, then the possible northerly extension has been removed by erosion. Conversely, the possibility of a continuation south depends on whether southerly downthrows by faulting have exceeded the effects of upward pitch, which, without the faulting, would have brought the mineralised zone above present ground-level. The theory offers a line of investigation to the management that might prove profitable.

Tin lodes in the granite of the Main Range in North Selangor have long been known, and some have been mined, most of them only in the weathered zone where the granite has been so much rotted by tropical weathering that it could be removed by hydraulicking. Besides providing tin ore, these operations washed away the cover of soil that hid tin-veins and enabled the discovery of lodes that paid for mining in hard rock. Undoubtedly, if it is possible to lead the tailings to an area whence they cannot burst out to cause damage, this is a most useful method of mining, and a geologist can be at hand to examine the evidence uncovered. Unfortunately, great trouble has been caused in the past because the

tailings were not kept under control. During the course of his detailed geological survey of North Selangor Mr. F. W. Roe collected much information about these lode-occurrences.

Mines in Alluvium.—It is not universally understood that all deposits of tin ore mined by alluvial methods have been derived from veins and lodes in solid rock. All grains of alluvial tin ore were once crystal imbedded in rock, and periodical examination of the alluvial tin mines is necessary to find the parent veins from which the alluvial ore came. Most of them were small, mere stringers of ore that have been completely removed, but some were large, and persistent in depth, and would pay for mining as lodes. There are many hundreds of mines in Malaya, operated by companies and individual owners, British and Chinese, and it is not possible for a staff of only seven geologists to pay regular visits to all of them. They have their mapping, their consulting work for miners, and various tasks for Government Departments concerning water-supply, quarry-sites, landslides, soil-surveys and so on, and they have their laboratory work and their office work to do, and but for the fact that there is an Intelligence Service ready to hand, provided by the officials of the Mines Department, and by the miners themselves, their attention would not be called to many interesting discoveries before the progress of mining operations hid them again.

Excavations have laid bare bedrock under soil and alluvium to give much information; improved methods of pumping have cleaned all gravel-pump mines and open-cast mines to rock-floor. In earlier years many mines did not reach bedrock, and the same areas were mined several times because previous operations had left payable tin deposits untouched.

There have been many cases of the discovery of lodes hidden until alluvial mining had uncovered them. A striking example was the Beatrice Mine, 2 or 3 miles from Ipoh, near the granite-limestone contact at the west side of the Kinta Valley. A small gravel-pump mine was operating in alluvium for two years beginning in August 1921 and, up to July 1923, it had recovered 57·7 tons of tin ore valued at £6,050. It was an ordinary gravel-pump mine, just paying its way, with nothing to distinguish it from hundreds of similar Chinese-owned concerns. Then an extraordinary deposit of black sand rich in arsenopyrite and cassiterite was found in a large cup in the limestone floor, and the cap of a lode was uncovered. A syndicate of Chinese, with capital £468, took charge of operations, which now consisted in blasting a great hole downwards into the crystalline limestone following a large pipe of ore; and in six years they had sold tin ore to the value of £1,750,000.

Apart from the value of the deposit, it was interesting from the scientific point of view, because the pipe consisted chiefly of tremolite impregnated with cassiterite and arsenopyrite. A rare fluoborite mineral also was present. In April 1929 the pipe in limestone came to an abrupt end against granite at a depth of

400 ft. Geological investigation showed a well-defined fault, separating crystalline limestone and granite, and dipping eastwards at 45°. The Chinese owners were advised to prospect for the root of the pipe in granite, and they began to do so, but stopped before any real test had been made because there was now no ore in sight and it meant using some of their profits. The underground workings have long been filled with water. The locality should be prospected by diamond-drilling with bores sited to avoid the old stopes. The plans prepared by the Geological Survey should be still available if they were not destroyed during the Japanese occupation.

Another discovery was made in a similar way when the mining of alluvial tin ore at Kramat Pulai, 6 miles from Ipoh, near the granite-limestone contact on the east side of the Kinta Valley, uncovered bedrock of schist penetrated by a vein that passed down into a great block of ore consisting almost entirely of fluorite and scheelite. Geological investigation during the early stages of mining made clear the unusual structure of the ore-body, and prospecting by diamond-drill carried out as advised by the Geological Survey Department enabled the deposit to be mined successfully. It produced thousands of tons of scheelite, and it made Malaya the third largest producer of tungsten ore in the world from 1933 to 1936.

The structure was very interesting and is best explained by giving its geological history. A bed of shale rather more than 100 ft. thick was interstratified with the limestone. The vast mass of the Main Range granite came into place, aligned north and south, and the limestone and shale were changed by great heat and pressure to crystalline limestone and pyroxene-schist. They were bent into anticlinal folds with axes locally parallel with the side of the great granite intrusion and pitching south-west at a low angle. Veins of tin ore were formed at a late stage of the consolidation of the granite. Vertical dykes of aplite were intruded into the granite, limestone and schist, at right angles to the run of the country, and some of them played an important part in isolating a large block of limestone underlying the schist. After the completion of the tin-mineralisation process, a distinct, later, low-temperature process of tungsten-mineralisation took place. Solutions rich in tungsten and hydrofluoric acid emerged through cracks in the solid granite and passed in great quantity into the block of limestone imprisoned between walls of aplite and under its roof of schist. The mineralising solutions were trapped there and could not disperse. Chemical reactions resulted in wholesale replacement of the limestone by fluorite (calcium fluoride) and scheelite (calcium tungstate).

Small veins of scheelite are known along 10 miles of country beside the granite at this eastern side of the Kinta Valley, some of them in cracks in the same band of schist, and it is possible that there may be other rich deposits of scheelite in depth imprisoned

under it. The discovery at Kramat Pulai was fortuitous. It was a lucky chance that erosion had worn through enough of the schist-roof to uncover the top of the ore-body, and that the beds of sand subsequently laid over it contained tin ore, otherwise they would not have been removed and the scheelite ore would have remained hidden.

It might be said that drill-holes should be bored through the schist to search for scheelite, but, except in special cases, this would not be practicable. At many points the schist must be underlain by granite or aplite. Moreover, drilling operations in the schist are exceedingly difficult. Not one single hole was drilled through its full thickness at Kramat Pulai. Its thin component folia are layers of quartz packed with tiny crystals of minerals of different hardnesses—biotite, pyroxene, hornblende and garnet—and usually the folia lie at an angle to the direction of advance of the drill. While the crown is rotating, the diamonds at one side are cutting into one layer while those opposite are grinding into another the resistance of which is quite different, so that strains are unequal and stoppages through breakage are frequent.

It is important that geologists shall visit the tin mines of eastern Kinta periodically to make sure that significant indications are not missed.

Unfortunately, very little information about the structure of bedrock under the dredged areas can be obtained, and the chances are that most of the payable lodes there will remain undiscovered. The Geological Survey is always available to report on unusual specimens brought up in the buckets, and the exact place of origin of any significant mineral occurrence is marked on large-scale maps. There is at least one locality in Perak indicated by dredging where payable lode-tin may occur; it is at the contact of granite with metamorphosed limestone and shale buried under deep alluvium in swampy country, and, because of all the water, it could not be mined by any present-day method other than dredging. The record kept by the Geological Survey may prove valuable in the future if a way can be devised to deal with the water. This locality should be prospected by drilling into bedrock below the tailings.

Locating deeply-buried Alluvial Tin Deposits

It is a matter of great interest to determine under what parts of the coastal plains lie deeply-buried, old, alluvial tin deposits. We already know of some, where the most westerly tin-bearing hill-ground of Lower Perak juts into the plains, within a few miles of the mouth of the Kinta River. Another is the area in Selangor dredged for years by the Hongkong Tin Company, the Killinghall Tin Company and the Ayer Hitam Tin Company, where the Klang River debouches into the coastal plain. The first application to prospect this area came as the result of a Geological Survey Department publication.

These deep tin deposits were laid down by rivers long ago, when the rock-floor on which they now lie almost one hundred feet below sea-level was at or slightly above sea-level. That period probably was more than 100,000 years ago. We geologists have not yet found the means of determining the period. A small part of the missing time-scale is provided by the fact that, long after the land had fallen to its present level, it has taken the rivers on the mainland opposite to the island of Penang a matter of 5,000 years to build the plain the final 3 miles which pushed the sea out to its present position; the full width of the coastal plain there is 10 miles, and the inference is that sea and land came to their present levels about 15,000 years ago.

It is likely that, when the land was at a level 100 ft. higher above the sea than now, besides the tin-bearing hills that are now visible, there were others nearer the sea and now buried under the plains. When at their higher level, these hills underwent erosion and alluvial tin deposits were laid down alongside.

A study of the geological map gives ideas as to where to look for them, though it is not possible to say with certainty where they are. It is hoped that further discoveries of deep tin deposits in the coastal plains will be made, and that research by mining engineers will give the means to mine them. We do not yet know enough about the recent geological history of Malaya to be able to say to what depths we may expect these old alluvial tin deposits to continue.

Other Services provided by the Geological Survey

Reports on ore-deposits and on the geological structure of mining properties and on such matters as water-supply are furnished for a nominal fee. Many assays, mineral analyses and screen analyses are undertaken, and identifications are made of minerals and rocks.

Besides the many thousands of reference specimens and microscope slides registered and indexed for the use of the staff at the Head Office of the Geological Survey, there are showcases exhibiting a suite of Malayan rocks and minerals available for examination by the public at any time during office hours. There are many photographs, too, of geological and mining interest, with detailed descriptions.

Every year an organised visit is made by the members of the Federated Malay States Chamber of Mines to the Head Office and Laboratories of the Geological Survey where they hear lectures by the geologists and see exhibits illustrating the activities of the Department. It is said that this visit is looked forward to by miners, and it is certainly a great help to the geologists. It reminds them of their responsibilities on the economic side of their work, and gives an excellent opportunity for useful discussion.

Central Collection of Prospecting Results

For twelve years before the Japanese invasion a search had been conducted, under the supervision of Dr. F. T. Ingham, for results of old prospecting, and, with all present-day prospecting results also available, one central combined collection had been prepared at the Head Office of the Geological Survey. Steady progress had been made in analysing the material, the value of which varies according to the equipment that was used and according to the thoroughness with which the prospecting had been conducted.

Any person proposing to prospect in any part of Malaya is able to get information contained in this Central Collection about the area that interests him. Due regard is made to the need for keeping confidential the value of mineral deposits in properties covered by existing mining rights.

By using the mass of information contained in the Central Collection of Prospecting Results, added to that accumulated by detailed geological surveys, the staff of the Geological Survey have prepared maps of Perak, Selangor, Pahang and Negri Sembilan dividing the land into the following four categories :

(*a*) Mining Land
(*b*) Potential Mining Land
(*c*) Land where mineral deposits might be found
(*d*) Land that can be reserved for purposes other than Mining.

Before the Japanese invasion the British Residents of two of the four States had agreed to use this map for the purpose for which it was prepared, so that in these two States no land in categories (*a*), (*b*) and (*c*) could be alienated for purposes other than mining until its mineral possibilities had been investigated.

At present the area under category (*a*) comprises a very small proportion of the Federated Malay States. As geological investigation continues it will be possible to increase it at the expense of large areas whittled away from categories (*b*) and (*c*). The greater part of (*b*) and (*c*), however, will no doubt eventually be classified as land available for purposes other than mining.

In time the whole of Malaya will be divided into only two categories—Mining Land and Land available for other purposes—and the Geological Survey is the sole agency that can achieve this ultimate aim.

In conclusion, I thank Sir Harry Lindsay, K.C.I.E., C.B.E., Director of the Imperial Institute, and his staff, for the help given me in presenting this paper.

Discussion

The **Chairman** (Mr. A. Creech Jones, M.P., Parliamentary Under-Secretary of State for the Colonies), in introducing the lecturer, said that he was very happy to have the privilege of presiding at the lecture. He expressed on behalf of the Colonial

Office and the Government their very great appreciation of the work that was done at the Imperial Institute in furthering the welfare of the Colonies and, indeed, of mankind generally. The scientific work done, the exchange of information, the effort to stimulate interest in research all counted for a great deal in furthering the purposes that Britain sought to serve.

Britain had undertaken the responsibility of building up the social and economic life of the people under her control. The furtherance of this work must depend on exact knowledge, on research, and on the application of science in the day-to-day administrative work and in the technical services of the Colonies. The contribution made by the Imperial Institute was one of considerable importance, particularly in our work of building up the standards of life of the people for whom we were responsible.

He appreciated the vital importance of the Institute's work from inside the Colonial Office. Nothing seemed more necessary than that the economic resources of the Colonies should be exploited and developed in order to sustain the social standards and the degree of political democracy it was hoped to achieve. Good health and education, good standards of living, and housing cannot depend merely on the resources of Britain herself. It was imperative that in the Colonies the local resources should be utilised to the full, particularly as a point might be reached some time later on when Britain might not be able to offer the assistance she was now able to give. It would be a catastrophe if these services were to fall to the ground because external help was not forthcoming. It was therefore important that alongside the work on education and health we should plan and create the economic equipment of the Colonial countries. We should sink capital in those countries for the development of their economic resources. He attached major importance to the kind of problem to which they were addressing themselves that afternoon.

We ought also to know what the resources of the countries were. There were still regions inside the Colonial Empire where our knowledge was of a very restricted character and where a great deal of surveying needed to be done. All admitted that it was fundamental to planning that we should know the possible resources so that we might be able to have long-term programmes, and know the extent to which we could rely on the country itself for sustaining the changes that were being made. Therefore, he counted of great importance the work of surveys and particularly of geological surveys.

That afternoon they were to hear something about the work done in Malaya and it was his privilege to welcome as lecturer Mr. Willbourn, Director of the Federated Malay States Geological Survey, who for the last 15 or 16 years, except for the period of the Japanese war, was the principal director and inspirer of the work on minerals that went on there. Mr. Willbourn could speak

with a unique knowledge because a great deal of his official career had been spent in Malaya—ever since 1914. They would particularly welcome him because he had gone through the horrors and the trying conditions of the Japanese invasion, and had fortunately survived that terrible ordeal.

After the lecture the **Chairman** expressed regret that Mr. J. B. Scrivenor, the first Director of the Malayan Geological Survey, had been prevented by illness from being present, but remarked that a letter from him would be read. He called upon Professor Jones to open the discussion.

Professor W. R. Jones was sorry that Mr. Scrivenor could not be there to open the discussion.

Malaya was an outstanding example of a country that owed its development to mining engineers. For many years before it produced rubber it was an extremely important source of tin. The administration of Malaya exemplified in a very marked manner the almost complete unawareness of the Colonial Office, in the early days, of the services that could be obtained by employing geologists, especially in a country the bulk of whose revenue came from its mineral resources. It was not until 1903 that Mr. Scrivenor was appointed as the sole geologist in a country the size of England, and nine years elapsed before a second geologist (the speaker) was appointed.

As an example of the services a strong Geological Department could have rendered the country in those early days, he instanced the location of the main road and railway through the Peninsula. It happened that both ran for considerable distances along the western foothills of the Main Granite Range where most of the tin mines were situated. Along this belt, where the streams left the granite country and entered much softer rocks, they changed their grade very rapidly and commenced to deposit their burden. In other words, the road and railway were in the very worst place they could possibly have been constructed, and a strong Geological Department in those days could have saved the Government literally hundreds of thousands of pounds.

In particular, Professor Jones instanced the town of Kuala Kubu at the foot of the main granite range just where the grade of the Selangor river flattens suddenly. When he was mapping that country geologically, there were literally scores of tin mines working on the steep slopes of the granite, laying bare very extensive areas, and it was perfectly clear that the stage had already been reached in those early days when nothing could be done to save the railway and the road from flooding. They raised the road, then they raised the railway and rebuilt the station at a higher level. He did his utmost at that time to point out that all this was quite useless—it was impossible to save them. Eventually the road and the railway had to be moved about a quarter of a mile westwards where they should have been built at the start. Ultimately the

whole of Kuala Kubu was covered to well over the housetops. The same thing happened along quite extensive parts of that main road. He drew attention to this matter in order that it should not occur again in parts of the Empire where there was no Geological Department.

Professor Jones found it extremely cheering to hear the Parliamentary Under-Secretary's views about the future of our Colonies and he hoped that Mr. Creech Jones would remember what had happened in the past in the case of Malaya. He congratulated Mr. Willbourn on his excellent lecture, and on looking so well after the severe time he had had during the Japanese occupation.

Mr. J. B. Scrivenor, I.S.O. (communicated), congratulated Mr. Willbourn not only on his lecture, but also on the completion of his sterling work in Malaya. At the end of 1946, when he was due to retire, Mr. Willbourn would have completed 31 years service. Prominent among Mr. Willbourn's achievements had been the mapping of outcrops of granite in difficult country in Selangor that led to the establishment of some of the richest tin-dredging properties in Malaya. The revenue the Federated Malay States derived from these properties doubtless very greatly exceeded the total cost of the Geological Survey.

Mr. Scrivenor acknowledged the valuable help received from the Imperial Institute and from its publications. He had been surprised to find from a review of colonial geological surveys published in the *Bulletin of the Imperial Institute* in 1943 that Malaya had a longer record of continuous official geological work than any other colony or dependency.

He hoped Mr. Willbourn would enjoy a long retirement, and that his successor might be able to extend the survey to Borneo and even to the British Pacific Islands. In this connection he mentioned the friendly relationships that had existed between the Geological Surveys of Malaya and neighbouring territories, and the fact that the work of all of them had led to concordant results was reassuring. There was, he thought, only one outstanding problem, namely, the equivalent in Malaya of the Mergui Series in Burma, if one existed.

Mr. J. V. Cowgill, C.M.G. (British Resident, Negri Sembilan), said that the regional maps referred to by Mr. Willbourn, showing zones of mining land, potential mining land, and non-mining land were of very great value. They were only a beginning of a development which he hoped to see go very much further. One of the problems of local government in Malaya in recent years had been how to deal with the large number of applications for prospecting for future mining land. The problem of the Government, when confronted with an application for prospecting over a large unknown area, was that that area usually comprised, in whole or in part, many thousands of acres of land which were already marked down by law for Malay reservation, or for forest reservation, or for both.

The administrator was confronted with the conflicting interests of the miner, the Forest Department, and the Malays. If, as he was often pressed to do by the miner, he allowed him to go in and prospect with no obligation on any side, he knew that the miner was bound to spend a certain amount of money if he were to do any good at all. If the miner were to find promising results, there was always a moral obligation in some degree which gave him some claim to mining that land. The solution seemed to the speaker, and not to him only, to lie in the hands of the Geological Department.

Prior to the Japanese invasion some steps had already been taken to organise bands of mining prospectors who were to be members of the Geological Department. Thus Government geologists were to do work which hitherto had only been done by private prospectors. That seemed to be a move in the right direction because it would benefit the miner without involving him in any expense. If would benefit the Government, and it would benefit the people of the country. It would lay the expense and the trouble of that particular problem where they belonged, namely, on the Government. He hoped that one of the major future developments of the Geological Department would be the assistance it could give the mining industry by carrying out preliminary prospecting over large areas.

Mr. Willbourn, in reply, thanked Professor Jones, his old colleague, for opening the discussion and expressed regret that Mr. Scrivenor was not there.

He was glad Mr. Cowgill agreed so wholeheartedly with the regional planning. The Geological Survey would have done a very good job of work when it had eventually prepared that map dividing Malaya into two categories of land, so that the Land Office of the British Resident would know straight away whether or not land could be used for Malay reservations and so on without blanketing that very mineral wealth which ought to be developed. Prospecting by the Geological Survey had been begun. They had the two schemes going when the Japanese interrupted them, but the speaker had no doubt that, under his successor's direction, there would be many more such schemes to solve the problems that would arise.

The **Chairman** said that for his part the lecture had been very interesting. He thought sometimes that the technical staffs in our Colonial Empire felt that the work they did was not appreciated to the full, not only in the country of their work, but also at the centre of the Colonial Empire itself. In colonial administration there was a continuing difficulty in how to keep that proper balance between the political administrator and the professional and technical worker. All would recognise the fundamental importance of geological work and he hoped that more young men of scientific training would see the opportunities there were in the Colonia Empire for serving their particular science.

The skilled technician was vital to colonial progress. The colonies could not attain the wider freedoms and the higher standards without harnessing to development organisation, research and science. It was necessary to encourage surveys, to extend industrial possibilities, and to develop mineral wealth.

The Chairman expressed to Mr. Willbourn very sincere thanks and appreciation for the work he had done with his colleagues in Malaya and for his most interesting lecture.

Mr. S. J. Johnstone proposed a hearty vote of thanks to Mr. Creech Jones for taking the chair, after which the audience inspected a special exhibition of Malayan minerals, publications and geological maps.

ABSTRACTS AND NOTES

Obituary.—E. H. Cunningham-Craig. It is with deep regret that we record the death on April 24, 1946, at Beaconsfield, of Edward Hubert Cunningham-Craig, B.A. (Cantab.), F.R.S.E., F.G.S., at the age of 72. Mr. Cunningham-Craig's association with the Imperial Institute dates back as far as 1925, when the late Imperial Mineral Resources Bureau (of whose Technical Committee on Petroleum, Asphalt, Oil Shales and Natural Gas he was a member) was amalgamated with the Institute. He retained his membership of the newly-formed Advisory Technical Committee, and was still a member of the Consultative Committee on Coal and Petroleum, as it was later called, at the time of his death. After so long an association, during which he placed his wide experience and invaluable advice so unreservedly at our disposal, his place will be hard to fill.

Born in Edinburgh in 1874, Cunningham-Craig was educated at Trinity College, Glenalmond, and Clare College, Cambridge. In 1896 he joined the staff of H.M. Geological Survey, and in 1903 was seconded to the Colony of Trinidad and Tobago. As a result of his detailed mapping of Trinidad, he drew attention for the first time to the petroleum possibilities of the island.

In 1907 he resigned from Government service and devoted the years before the 1914-1918 war to geological surveying and investigations in many parts of the world. During that war he held a number of important official appointments and afterwards resumed consultative work. He was a Founder Member, and, for many years, a Member of the Council of the Institution of Petroleum Technologists, and was the author of numerous works on the geology and technology of petroleum.

Retirement of Mr. Sydney J. Johnstone.—The Institute lost the services of its most senior scientific officer on May 6, 1946, when Sydney J. Johnstone, O.B.E., B.Sc., F.R.I.C., M.Inst.M.M.,

Principal of the Mineral Resources Department, retired on reaching the age limit, after more than 43 years' service. A link is thus broken with some of the earliest years of the scientific and technical activities of the Institute.

Johnstone was educated at the City and Guilds Technical College, Finsbury, and at Birkbeck College, taking his B.Sc. (Hons.) degree in Chemistry with subsidiary Geology, and entered the service of the Institute in February 1903 as Junior Assistant in the Scientific and Technical Department. His earliest duties involved the chemistry of drugs, rubber, etc., but he soon transferred, at his own request, to the Mineral Section where he gained wide experience in the chemical analysis and commercial applications of economic minerals and in small-scale technical trials. Much of the laboratory work from 1905 to 1912 consisted in the examination of a very large number of mineral specimens collected during the course of the Mineral Surveys of Nigeria, Nyasaland and Ceylon, which at that time were being conducted under the auspices of the Imperial Institute and were the forerunners of the respective Geological Survey Departments. Among the samples, especially from Ceylon, were many that contained the rarer metals and the rare earths, and so it was that Johnstone came to make a special study of the analysis and industrial applications of these metals and to write his well-known book, *The Rare Earth Industry*, and several papers on kindred topics.

From 1920 onwards he was in charge of all chemical and laboratory investigation of minerals and of much of the mineral intelligence work as well. He became Vice-Principal of the Intelligence Section in 1929, and Principal in charge of the Mineral Resources Department in 1937.

At the outbreak of war in 1939 the intelligence staff of the Mineral Resources Department, together with the Statistical Section and five officers of the Plant and Animal Products Department, were seconded to the Ministry of Economic Warfare where, under Johnstone's direction, they constituted the Commodities Intelligence Section of the Ministry until April 1940.

In addition to many contributions to this BULLETIN, Johnstone wrote the Imperial Institute monographs on *Zinc* (1917) and *Potash* (1922), and a particularly valuable compilation in 1936 entitled *Mining Royalties and Rents in the British Empire*. He was Secretary of the Advisory Council on Minerals, the Consultative Committee on Chemical Industries, and the Mining Law Technical Committee, and represented the Institute on numerous official committees and professional bodies. Among the latter he had served on the Councils of the Royal Institute of Chemistry and of the Society of Chemical Industry. In 1942 his valuable services were recognised by the award of the O.B.E.

In the course of 43 years spent in the service of the Empire, Johnstone made many friends overseas as well as at home, some

of them of very long standing, and all of these will wish him well in his retirement. He takes with him also the sincere wish of all his colleagues at the Imperial Institute that he may enjoy many richly-deserved years of recreation and happiness.

Mineral Production of Southern Rhodesia.—Statistics of the production of minerals in Southern Rhodesia during the war years have lately been released for publication and are given on p. 151. It will be noted that chrome ore production was stepped up to the record figure of 342,815 long tons in 1942 while coal production exceeded 1¾ million tons in both 1943 and 1944. Other striking increases in production to meet the needs of the allied fighting services were those of tungsten concentrates and mica.

W. B.

Mineral Production and Exports, Nigeria.—The following table of production and exports of minerals has been compiled partly from the official Trade Reports and partly from statistics received from the Chief Inspector of Mines in Nigeria.

NIGERIA—MINERAL PRODUCTION AND EXPORTS, 1941-1945

		Tin Ore Estimated 72·5% Sn *Long tons*	*Columbite* Estimated 65% Cb_2O_5 *Long tons*	*Tantalite* Estimated 55% Ta_2O_5 *Long tons*	*Wolfram* Estimated 65% WO_3 *Long tons*	*Gold Bullion* 880 fineness *Troy oz.*
1941	Production	16,578	422	—	22	21,910
	Exports	18,401	632	—	38	22,636
1942	Production	17,107	865	—	90	43,747
	Exports	16,557	960	—	87	42,410
1943	Production	17,463	802	2	68	17,413
	Exports	17,449	831	2	84	19,928
1944	Production	17,258	2,072	13	28	8,995
	Exports	18,178	1,567	13	44	10,709
1945	Production	15,482	1,571	13	5	9,214
	Exports	15,213	1,975	14	10	8,021

W. B.

Mineral Production of Sierra Leone.—The Chief Inspector of Mines reports the following mineral production for the year 1945 with corresponding figures for 1944 shown in brackets.

Crude gold and unrefined gold bullion, 291 (1,117) troy oz., estimated to contain 274 (1,014) troy oz. fine gold. Coarse crude platinum 16 (Nil) troy oz. Chromite 569 (9,695) tons. Figures for diamond production and iron-ore exports are not available.

During the year no Africans were employed in prospecting, but in mining the average number employed rose from 5,930 in the first quarter of the year to 6,764 in the fourth quarter.

W. B.

Mineral Production of Uganda.—The mineral production figures for Uganda for the year 1944 which have only recently been released (*Ann. Rep. Land and Survey Dept., Uganda*, for 1944), contain

SOUTHERN RHODESIA—MINERAL PRODUCTION, 1940-45

	Units.	1940.	1941.	1942.	1943.	1944.	1945.
Gold	*Oz.*	826,485	790,442	760,030	656,684	592,729	568,241
Silver	,,	186,080	170,364	163,776	119,322	103,776	95,974
Antimony ore	*Long tons*	181	148	302	291	206	52
Arsenic	,,	5	—	172	1,654	844	434
Asbestos	,,	50,007	39,405	49,824	51,916	52,047	50,311
Barytes	,,	384	1,050	2,633	1,236	13	—
Chrome ore	,,	243,813	318,821	342,815	282,914	272,677	183,377
Coal	,,	1,270,279	1,389,677	1,535,934	1,750,611	1,779,177	1,642,485
Copper ore	,,	436	499	263	497	98	155
Corundum	,,	88	31	73	43	—	—
Fluorspar	,,	—	—	98	293	—	—
Iron ore	,,	—	310	179	179	—	—
Iron pyrites	,,	33,836	41,935	37,060	34,512	33,638	32,937
Kaolin	,,	61	16	130	56	119	9
Lead	,,	46	—	3	3	296	—
Limestone	,,	98,286	108,301	108,991	109,370	95,688	109,092
Magnesite	,,	499	2,230	2,746	5,342	5,043	4,211
Mercury	*Lb.*	277	170	206	33	—	50
Mica	*Long tons*	4	9	12	53	246	194
Tantalum ore	,,	7	16	13	6	5	6
Tin concentrates	,,	643	330	231	254	175	179
Tungsten concentrates	,,	223	240	458	733	688	261

several points of interest, as also do the statistics for mineral exports. Indeed, the value of mineral exports was considerably higher than in the previous year despite a further large decrease in the export of gold. This decrease was more than covered by a sharp increase in the export of wolfram.

The production of gold continued to decline as a result of the war-time policy to encourage the mining of base metals, the export figures for the war years being (after melting): 1940, 12,309; 1941, 10,691; 1942, 10,869; 1943, 4,573; 1944, 3,143 oz.

Tin production has been maintained at a fairly steady level, the metal content of ore exported being: 1940, 330; 1941, 306; 1942, 283; 1943, 296; 1944, 281 tons.

In view of the rise in the price of tin from £292 to £300 as from July 1, 1944, the royalty was changed as from October 1, 1944 from 8 per cent. based on a price of £277 18*s*. 4*d*. to 5 per cent. on the gross sum realised. The Mwirasandu mine of Messrs. Kagera Mines, Ltd., remained the main source of supply of tin, producing 108 tons.

The total output of wolfram rose from 29 tons in 1943 to 80 tons in 1944. The greater part of this came from Kigezi, for which Kagera Mines, Ltd., acted as Government Collecting and Forwarding Agents, but, owing to the increase in the production from Buganda, it was found necessary to open a sub-agency in Kampala. Towards the end of the year a marked falling off in production was noticeable, owing, no doubt, to nervousness as to the future.

By an agreement made between the Director of Geological Survey, Uganda, and Ankole Mines and Estates, Ltd., the former took over as from July 1, 1944, one of the Company's most potentially productive claims situated at Kanena, Ankole, in order to apply intensive mining methods over the shortest possible period, and as a result about 1½ tons of tantalite valued at about £696 were obtained. Most of this production remained for export in 1945. No comment is made on the tantalite exported in 1944, but it will be seen from the valuation, £1,410 for 1¼ tons, that it was evidently high grade.

Bismutotantalite, a bismuth tantalate and columbate, when discovered in Uganda nearly twenty years ago, was a mineral new to science and its occurrence is still restricted to Uganda. The 1944 export is the first to be recorded and the commercial valuation of about £320 a ton is of interest. Beryl, usually found with tantalite in Uganda, also appears on the export list for the first time. The price obtained was about £22 per ton. Exports of mica rose from under one ton in 1943 to nearly 12 tons in 1944. The greater part of this came from the Karamoja District, some 2½ tons only being produced from Ankole and the West Nile Districts.

The production of rock phosphate at Busumbu in the Bugishu District was most disappointing, little information or experience of dry-grinding methods and equipment being available and time

did not permit of the import of the special machinery required. As a result production did not commence until November 1944, the output subsequently reaching 150 to 200 tons per week. The whole of the production goes to the Kenya Settlement and Production Board for fertilising purposes.

In 1944 exports of minerals from Uganda, as given in the publication cited above, were as follows, statistics for 1945 which have now been received from the Director of the Geological Survey for the Protectorate being also shown for comparative purposes.

EXPORTS OF MINERALS FROM UGANDA IN 1944 AND 1945

	1944		1945	
	Quantity	Value	Quantity	Vulue
		£		£
Gold	3,214 *troy oz.*	21,767	2,747 *troy oz.*	19,800
Tin	388 *tons*	83,225	215 *tons*	64,381
Tantalite	1¼ ,,	1,410	7 ,,	3,240
Columbite	5⅛ ,,	2,077		
Bismutotantalite	3 ,,	952	—	—
Wolfram	80 ,,	27,367	80 ,,	21,262
Beryl	18 ,,	399	—	—
Mica	11¾ ,,	4,097	—	—

A. W. G.
W. B.

Geological Work in Tanganyika.—The following account of the work carried out by the Geological Division of the Department of Lands and Mines, Tanganyika, during 1945 has been received from the Acting Chief Geologist.

Field Geology.—Three geologists were available most of the year and a fourth for part of it. The principal geological activity of the year has been the examination of the rocks exposed, and the recording of the data yielded, by the surface and underground prospecting of the Namwele (Ufipa) Coalfield; and the search for new coal areas in the north-western Rukwa valley, which involved supervision of diamond drill holes.

In the Eastern and Southern Provinces, 2,000 sq. miles were covered by geological reconnaissance in the latter part of the year, thereby commencing the programme of completing the geological map of the Territory, even if only on reconnaissance standard, so that the possible mineral-bearing areas may be defined and their value assessed.

Detailed work was done on estimating the ore reserves and commencing a study of the economic geology of a very large lead deposit. A hundred tons of graphite ore were mined and transported to Dodoma ready for treatment next year. A large apatite limestone occurrence, possibly of use as a fertiliser, was also examined.

Laboratory Section.—Two metallurgists were in the laboratory throughout the year. The laboratory work increased in quantity and scope. Mineral dressing tests were carried out on coal, garnet,

kyanite, corundum, phosphate and gold. Tests on building materials (clay, bricks, tiles, cements) and on ceramic clays were continued. Experiments were made on the preparation of salt-lick bricks for cattle, the extraction of sodium sulphate from salt lake crusts, the treatment of apatite by calcination with soda to improve its fertiliser qualities. Approximately a thousand determinations, varying from complete analyses, through assays for gold and silver, to conductivity estimation of salinity of water, were done in the year. Ninety-six coal samples were analysed and very numerous ones subjected to other tests. Steaming tests on the railway were observed.

The Dodoma geological buildings were extended to accommodate further metallurgical machinery and expansion of the collections. A complete new continuous ore testing plant arrived and erection was commenced. Important results for the benefit of the mining industry are hoped for from this modern outfit.

War Substitutes Factory.—The abrasives factory closed at the end of the war having made in all 88,000 articles of which 82,700 were urgently needed slipstones for the rubber industry. 101,000 slate pencils were made from local soapstone to meet a shortage.

Publications.—A paper on the mining geology of the Iramba-Sekenke goldfield was published in the *Bulletin of the Imperial Institute*. A pamphlet on the assaying of gold and silver was published and a paper on the local manufacture of abrasive articles (hones, slipstones, wheels) was prepared. Twenty-one mineral resources pamphlets were published in typescript.

Radio-Active Minerals Restrictions in the Gold Coast.—In a recent issue of this BULLETIN (1945, **43**, 322-323) a note appeared on uranium and thorium restrictions in the Union of South Africa and the Mandated Territory of South-West Africa. In the supplement to the *Gold Coast Gazette No.* 10, dated February 16, 1946, there appears a bill entitled " An Ordinance to regulate and control prospecting and mining for radio-active minerals and the export thereof and for purposes connected therewith," the short title being " The Radio-Active Minerals Ordinance, 1946."

Under this ordinance no person is allowed to prospect for or mine any radio-active mineral except under licence granted by the Governor. Every holder of such a licence has to furnish every month a written report of the prospecting and mining operations conducted by him. No person is allowed to export any radio-active mineral except under and in accordance with a permit granted by the Governor. Penalties for infringement are twelve months' imprisonment or a fine of £500 or both. Powers of examination are granted to the Police, Mines Department, and Geological Survey Department. Penalties for obstruction are six months' imprisonment or a fine of £100 or both.

The schedule of minerals covered by this ordinance is rather more specific than that applying in South Africa and is as follows:

(1) Minerals of the pitchblende group, including pitchblende, uraninite, ulrichite, bröggerite, cleveite, and related mineral species.
(2) Torbernite and autunite.
(3) Secondary uranium minerals other than torbernite and autunite, including rutherfordine, uranite, uranophane, gummite, thorogummite, uranocircite, kasolite, becquerelite, and other silicates, hydrates, carbonates, phosphates or arsenates of uranium.
(4) Carnotite and tyuyamunite.
(5) Uranium-bearing niobate-titanate-tantalate ores, including euxenite, polycrase, blomstrandine, priorite, samarskite, fergusonite, betafite, plomboniobite, and related mineral species containing over one per cent. uranium oxide.
(6) Monazite, thorite, thorianite and radio-active zircon.

The ordinance applies also to Togoland and to the territorial waters of the Gold Coast.

A. W. G.

BOOK REVIEWS

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

STANDARD METHODS OF ANALYSIS OF IRON, STEEL AND FERRO-ALLOYS (as used by the Laboratories of The United Steel Companies Limited). Third Edition, 1945. Pp. vii + 93, 9 × 6. (Sheffield: The United Steel Companies, Ltd., 1945.) Price 7*s*. 6*d*.

The first edition of this book appeared in 1933 and was reviewed in this BULLETIN (1934, **32**, 190). A second edition of 81 pages was published in 1936 and, owing to the considerable time which has elapsed and the many recent developments in analytical methods, the present (third) edition represents a complete revision of this.

The size of the book has almost trebled since the first edition; indeed, as a result of the growing complexity of steel analysis, its scope has been greatly enlarged, methods for the determination of columbium, lead, nitrogen, selenium and tin, which were absent from the second edition, being now included.

The book is confined, as formerly, to standard methods of chemical procedure, but it is hoped to deal in a further publication with the applications to steel analysis of physical methods involving the use of the absorptiometer, spectrograph and polarograph. The methods selected are orthodox but modern, and, although references are not given, they have, in most cases, been thoroughly investigated and described in the literature. Working instructions and explanatory notes are given in ample detail. Emphasis is laid on accuracy rather than speed, and rapid works control methods

do not come within the scope of the book. Chemists engaged in the examination of steels and ferro-alloys will find this collection of methods of considerable use, but the book should be of wider appeal, as many of the procedures described can, with little alteration, be adapted to the examination of ores and inorganic materials generally.

W. H. B.

HANDBOOK OF THE WEST AFRICAN GOLD MINES. Compiled by H. Taylor, M.C. Pp. 110, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: New York: Melbourne: Sydney: Hutchinson's Scientific and Technical Publications, 1946.) Price 16*s*.

Apart from a small pamphlet published in 1932 and again in 1934, entitled *West African Gold*, there has hitherto been no handy work of reference to the companies engaged in gold mining or mining finance in West Africa.

The present work, which fills this gap, is similar in scope to that of other mining year-books, and gives the directorship, registered offices, capitalisation, and earnings of the various companies enumerated. Since, however, the great bulk of gold production in West Africa comes from the Gold Coast, the work refers almost entirely to that Colony, although one or two companies with gold interests in Sierra Leone and Nigeria are included.

One of the most attractive and useful features of this handbook, and one which is not usually encountered in works of this nature, is a section for each company entitled "Prospects." In this section, the author discusses the nature of the company's operations, sometimes including a brief description of the mode of occurrence of the auriferous deposit; the method of working, together with any special features and difficulties; the financial situation of the company; how the concern was or is affected by the Concentration Scheme, and its probable future.

The handbook concludes with a short review of the course of the West African gold share market during 1945, and a short directory of Directors. Attached to the work is a map of part of the Gold Coast, on a scale of about 10 miles to the inch. This map shows the location of the mines and the extent of the various concessions, and is adequate for this purpose, but as it purports to show first, second and third-class roads as well, the absence, for example, from the map of any indication of the main road from the Tarkwa field to Takoradi is rather a notable omission. Apart from this and the somewhat loose definition of banket, quartz and winze, the *Handbook of the West African Gold Mines* is well produced and will make a useful addition to the previously existing mining year-books of the world.

E. R. V.

BIBLIOGRAPHY

Compiled by Miss J. M. Cullinan, B.A.

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the three months, February-April, 1946.

*The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.*1. *Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.*

OFFICIAL ANNUAL REPORTS

United Kingdom: List of Mines in Great Britain and the Isle of Man, 1944. *Ministry of Fuel and Power.* Pp. 295, 9½ × 5½. (London: Ministry of Fuel and Power, 1945.)

Northern Ireland: Report on the Mining and Quarrying Industries in Northern Ireland during the year 1944. *Ministry of Commerce.* Pp. 5, 13 × 8¼, and tables. (Belfast: H.M. Stationery Office, 1945.) Price 6*d*.

Swaziland: Annual Report of the Geological Survey Department for the year ended December 31, 1944. Pp. 27, 13 × 8. (Swaziland: Geological Survey, 1945.) Price 3*s*.

Canada: Annual Report on the Mineral Production of Canada during the calendar year 1943. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 315, 9¾ × 6½. (Ottawa: King's Printer, 1945.) Price $1.

Manitoba: Sixteenth Annual Report on Mines and Minerals for year ending April 30, 1944. *Mines Branch.* Pp. 113, 11 × 8½. (Winnipeg: Department of Mines and Natural Resources, 1945.)

British Columbia: Annual Report of the Minister of Mines for the year ended December 31, 1944. Pp. 212, 10½ × 7¼. (Victoria, B.C.: King's Printer, 1945.)

Western Australia: Annual Progress Report of the Geological Survey for the year 1939. *Geol. Surv. West. Austr.* Pp. 58, 13 × 8¼, and maps (Perth: Government Printer, 1940.)

MINING LAW

Nigeria: The Minerals Ordinance, 1945. Pp. 68, 9 × 7. (Lagos: Government Printer). Price 1*s*. 6*d*.

Nigeria: Regulations Made Under the Minerals Ordinance, 1945. *Nigeria Gaz.*, (*Extraordinary*), 1946, **33**, No. 9, 77-200.

COMMERCIAL INTELLIGENCE

Quin's Metal Handbook and Statistics, 1945. Pp. 367, 4¼ × 6¾. (London: Metal Information Bureau, 1946.) Price 10*s*.

1944 yilinda dünya madenciliği. [World Mining Industry in 1944.] *Maden Tetkik ve Arama*, 1945, **10**, No. 1/33, 17-41. [In Turkish.]

Preliminary Estimate of Canada's Mineral Production for the Calendar Year 1945. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 12, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1945.) Price 25 cents.

Canada's Mineral Industry in 1945. By W. H. Losee. *Canad. Min. J.*, 1946, **67**, No. 2, 76-83.

Metallurgical Works in Canada. Part I. Iron and Steel. *Mines and Geol. Br., Dep. Mines Res.* Pp. 8, 13½ × 8½. (Ottawa: Division of Economics, 1945.)

Metallurgical Works in Canada. Part II. Non-Ferrous and Precious Metals. *Mines and Geol. Br., Dep. Mines Res.* Pp. 10, 13½ × 8½. (Ottawa: Division of Economics, 1945.)

The Miscellaneous Non-Ferrous Metal Products Industry, 1944. [Canada.] *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 3, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1946.) Price 15 cents.

The Mineral Industry of Nova Scotia—Diamond Drilling and Geological Investigations. By D. L. Currie. *Canad. Min. J.*, 1946, **67**, No. 2, 112-113.

Quebec Annual Review—Activity on New Prospects Features the Current Situation. By J. C. Browning. *Canad. Min. J.*, 1946, **67**, No. 2, 107-111.

Statistical Review of the Mineral Industry of Ontario for 1940. By M. Tremblay. *Ann. Rep. Ontario Dep. Mines*, 1941, **50**, Pt. 1A, 1-72, with tables. (1945.)

Ontario Annual Review—Increased Production Follows Return of Army Personnel. By J. C. Browning. *Canad. Min. J.*, 1946, **67**, No. 2, 101-106.

Mining in Manitoba in 1945—Widespread Prospecting and Exploratory Activity. By J. P. de Wet. *Canad. Min. J.*, 1946, **67**, No. 2, 97-100.

Recent Work of the Research Council of Alberta. By E. Stansfield. *Canad. Min. Metall. Bull. (Bull. Sec.)*, 1946, No. 406, 121-128.

Review of Mining in British Columbia in 1945—Mineral Production Shows Slight Decrease. By F. H. Stevens. *Canad. Min. J.*, 1946, **67**, No. 2, 84-90.

Mineral Trade Notes. *U.S. Bur. Mines*, 1945, **21**, No. 3, 44 pp., 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Mineral Trade Notes. *U.S. Bur. Mines*, 1945, **21**, No. 4, 58 pp., 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Mineral Trade Notes. *U.S. Bur. Mines*, 1945, **21**, No. 6, 50 pp., 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Mineral Trade Notes. *U.S. Bur. Mines*, 1946, **22**, No. 1, 62 pp., 10½ × 8. (Washington; D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Türkiye madenciliğinin 1944 bilânçosu. [Review of Turkish Mining Industry in 1944.] *Maden Tetkik ve Arama*, 1945, **10**, No. 1/33, 5-16. [In Turkish.]

Madenciliğimizin 1945 yili ilk 6 aylik bilânçosu. [Review of the Mining Industry for the first 6 months of 1945.] *Maden Tetkik ve Arama*, 1945, **10**, No. 2/34, 287-295. [In Turkish.]

GEOLOGY AND MINERAL RESOURCES

The Geological Results of the Search for Oilfields in Great Britain. By G. M. Lees and A. H. Taitt. *Quart. J. Geol. Soc. Lond.*, 1946, **101**, Pts. 3 and 4, 255-317, and maps.

Stratigraphical Notes, Anglo-Egyptian Sudan. By G. Andrew and G. Yanni Karkanis. Pp. 10, 9½ × 6½. (Khartoum: Geological Survey, 1945.) Reprinted from *Sudan Notes*, 1945, **26**, Pt. 1.

Reports on the Geology and Hydrology of the Coastal Area East of the Akwapim Range. By N. R. Junner and D. A. Bates. *Mem. No. 7, Geol. Surv., Gold Coast.* Pp. 23, 13 × 8½. (Accra: Government Printing Department, 1945.) Price 6*s*.

Geological Survey of No. 2 Mining Area, Kavirondo—Interim Report and Map of the South-West Quadrant. By W. Pulfrey. *Rep. No. 7, Min. Geol. Dep., Kenya.* Pp. 64, 9¾ × 6, and map. (Nairobi: Government Printer, 1938.) Price 2*s*.

Kenya: Geology of the Nyeri Area. By R. M. Shackleton. *Rep. No. 12, Min. Geol. Dep., Kenya.* Pp. 26, 9½ × 7½, and map. (Nairobi: Government Printer, 1945.) Price Sh. 2.

Geology along the Trans-Canada Highway between Hearst and Longlac. By E. L. Evans. *Ann. Rep. Ontario Dep. Mines*, 1942, **51**, Pt. 9, 1-10, and map. (1945.)

The Barrington Lake Area ; Granville Lake Mining Division, Manitoba. *Precambrian*, 1946, **19**, No. 3, 4-6, 11.

The Tuya-Teslin Area, Northern British Columbia. By K. de P. Watson and W. H. Mathews. *Bull. No.* 19, *Dep. Mines, British Columbia.* Pp. 52, 10½ × 7½, and map. (Victoria, B.C. : King's Printer, 1944.)

Mineral Development in the Northwest Territories in 1945. By W. F. Lothian. *Precambrian*, 1946, **19**, No. 1, 5-9.

Les Exploitations Minières de Haute Montagne au Ruanda-Urundi. By P. Fontainas. *Mém. Inst. Roy. Colon. Belge*, (8° *Collection*), 1938, **1**, No. 4, 57 pp., 10 × 6½. (Brussels: Librairie Falk fils, Georges van Campenhout, 1938.) [In French.]

Perspectives Minières de la Région comprise entre le Nil, le Lac Victoria et la Frontière Orientale du Congo Belge. By P. Fontainas and M. Ansotte. *Mém. Inst. Roy. Colon. Belge*, (4° *Collection*), 1932, **1**, No. 5, 27 pp., 11½ × 9. (Brussels : Librairie Falk fils, Georges van Campenhout, 1932.) [In French.]

Étude Géologique et Recherches Minières dans la Contrée située entre Ponthierville et le Lac Kivu. By J. Henry. *Mém. Inst. Roy. Colon. Belge*, (8° *Collection*), 1934, **2**, No. 3, 51 pp., 10 × 6½, and maps. (Brussels : Librairie Falk fils, Georges van Campenhout, 1934.) [In French.]

French North Africa—Report of the Minerals Division, British Economic Mission, Algiers. Pp. 210, 12¾ × 7¾, and maps. (Algiers : British Economic Mission, Minerals Division, 1945.)

I—Subsurface Relations of the Maquoketa and " Trenton " Formations in Illinois. By E. P. Du Bois. II—Petroleum Possibilities of Maquoketa and " Trenton " in Illinois. By C. A. Bays. *Rep. Invest. No.* 105, *Illinois State Geol. Surv.* Pp. 38, 9¾ × 6¾, and maps. (Urbana, Illinois : State Geological Survey Division, 1945.)

O Sub-Solo do Império na Unidade Economica do Império e nas suas Relações com a Economia Nacional. By A. B. de Mello. *Bol. Geral. Colon.*, 1945, **21**, No. 246, 131-163.

Venezuela—The Llanos. By J. C. Davey. *Min. Mag., Lond.*, 1946, **74**, No. 3, 141-155.

PROSPECTING AND MINING METHODS

(*See also under Metals and Non-Metals.*)

Geophysics—Geophysical Activities in 1945 and the Geophysicists' Part in the War. By C. A. Heiland. *Min. and Metall.*, 1946, **27**, No. 470, 109-114.

Specimens and Samples—Their Treatment and Use. By Officers of the Department of Mines, Victoria, B.C. *Bull. No.* 18, *Dep. Mines, British Columbia.* Pp. 27, 10½ × 7½, and plates. (Victoria, B.C. : King's Printer, 1944.)

Driving of Two Drifts by the Desford Coal Co., Ltd., at Merry Lees, Leicestershire. By A. D. Butterley and G. H. Mitchell. *Trans. Instn. Min. Engrs., Lond.*, 1945, **104**, Pt. 12, 703-713, with diagrams and photographs.

Time Studies in Drilling, Haulage and Hoisting. By J. D. Forrester and J. F. A. Taylor. *Mine and Quarry Engng.*, 1946, **11**, No. 2, 37-43 ; No. 3, 67-71 ; No. 4, 87-88.

New Double Tube Drill Barrel—Success of South African Invention. *S. Afr. Min. Engng. J.*, 1946, **57**, Pt. 1, No. 2768, 17.

Diamond Drilling as applied to Ore Production. *Engng. Min. J.*, 1945, **146**, No. 10, 69-73 ; 1946, **147**, No. 1, 58-64 ; No. 3, 88-93.

Blast-Hole Diamond Drilling at the Sullivan Mine. By C. D. M. Chisholm. *Canad. Min. Metall. Bull.* (*Trans. Sec.*), 1946, No. 406, 63-78.

Metal Mining—Diamond-Drill Blasthole Stoping and Jumbo Drill Mounting Among the Notable Improvements. By E. D. Gardner. *Min. and Metall.*, 1946, **27**, No. 470, 67-69.

Sinking Large-Diameter Drill Holes, Lake Superior District Underground Iron Mines. By E. W. Johnson and F. E. Cash. *Inform. Circ. No.* 7354, *U.S. Bur. Mines.* Pp. 21, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Secondary Blasting and Car Loading at Flin Flon. By H. A. Kramer and G. M. Proudfoot. *Canad. Min. Metall. Bull.* (*Trans. Sec.*), 1946, No. 405, 22-31.

Trials of Reinforced Concrete Arches on Roadways. By W. H. Evans and A. Wright. *Iron Coal Tr. Rev.*, 1946, **152**, No. 4065, 141-146.

The Control of Mine Roadways. By T. J. Jones. *Iron Coal Tr. Rev.*, 1946, **152**, No. 4073, 529-532, 537; No. 4074, 579-582.

Locomotive Haulage Ways. By H. G. Smith. *Iron Coal Tr. Rev.*, 1946, **152**, No. 4071, 433-437; No. 4072, 495-500.

Improved Control of Mine Hoist Drives. By J. G. Ivy. *Canad. Min. J.*, 1946, **67**, No. 1, 20-23.

Report upon Lighting Performance of Safety Lamps in Coal Mines in Lancashire and North Wales. *Ministry of Fuel and Power.* Pp. 13, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 3*d.*

Mine Lighting. Extracts from the Report of the Mine Lighting Sub-Committee to the National Illumination Committee of Great Britain. *Iron Coal Tr. Rev.*, 1946, **152**, No. 4068, 303-306; No. 4069, 349-351; No. 4070, 387-389.

Provisional Statement of Number of Deaths by Accidents at Mines and Quarries in Great Britain, together with the Isle of Man, during 1945. *Ministry of Fuel and Power.* Pp. 6, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 1*d.*

Backfilling Problem in the Anthracite Region as it relates to Conservation of Anthracite and Prevention of Subsidence. By S. H. Ash and J. Westfield. *Inform. Circ. No.* 7342, *U.S. Bur. Mines.* Pp. 18, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Ripping and Fire-Fighting with Carbon Dioxide. By S. Atherton. *Iron Coal Tr. Rev.*, 1946, **152**, No. 4067, 239-241.

Sensitivity of Explosives to Initiation by Electrostatic Discharges. By F. W. Brown, D. J. Kusler and F. C. Gibson. *Rep. Invest. No.* 3852, *U.S. Bur. Mines.* Pp. 8, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Storage of Explosives in Underground Mines of the Lake Superior District. By F. E. Cash. *Inform. Circ. No.* 7343, *U.S. Bur. Mines.* Pp. 9, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Stench Warning Tests Lake Superior District Mines. By F. E. Cash and E. W. Johnson. *Rep. Invest. No.* 3850, *U.S. Bur. Mines.* Pp. 23, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Some Aspects of Industrial Safety and Accident Prevention in Coal Mines, with Special Reference to the Current Programme of the Drumheller Coal Operators' Association. By V. A. Cooney. *Canad. Min. Metall. Bull.* (*Trans. Sec.*), 1946, No. 405, 32-50.

Notes on Pressure Surveying—with particular reference to the Installation of an Inbye Fan. By G. Dunn and V. R. Clark. *Iron Coal Tr. Rev.*, 1946, **152**, No. 4069, 335-342.

Report on the Causes of, and Circumstances attending, the Explosion which occurred on the 4th March, 1945, at the Manvers Main Colliery, Wath-on-Dearne, South Yorkshire. By J. R. Felton, *Ministry of Fuel and Power.* Pp. 28, 9½ × 6, and maps. (London: H.M. Stationery Office, 1945.) Price 1*s.* 3*d.*

How's Your Fire Protection? By H. B. Hicks. *Canad. Min. J.*, 1946, **67**, No. 1, 32-34.

The "Know-How" in Fighting Silicosis with Aluminum. By A. W. Jacob. *Engng. Min. J.*, 1946, **147**, No. 3, 70-75.

Suggested Methods for Installing Dust-Allaying Equipment in Bituminous-Coal Mines. By C. W. Owings. *Rep. Invest. No.* 3843, *U.S. Bur. Mines.* Pp. 31, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

The Resistance of Stemming: Dynamical Investigations. By J. Taylor. *Trans. Instn. Min. Engrs., Lond.*, 1945, **105**, Pt. 2, 51-74.

Air Cooling Plant, No. 4 Shaft, City Deep, Ltd. A Review of Layout and Results Achieved. By H. W. Unwin, A. Malcolm and R. E. Campbell Pitt. *J. Chem. Metall. Min. Soc. S. Afr.*, 1945, **46**, Nos. 3 and 4, 66-119, including diagrams, tables and discussion.

The Prevention and Suppression of Coal-Dust in Mines. By H. Watson Smith and H. F. Banks. *Trans. Instn. Min. Engrs., Lond.*, 1945, **104**, Pt. 11, 602-621, and plate.

Practical Training being the Third Report on Qualifications and Training for Mining Engineers prepared by the Examinations Board (formerly Committee on Qualifications and Training for Mining Engineers.) *Trans. Instn. Min. Engrs., Lond.*, 1945, **105**, Pt. 1, 2-7.

The Time Factor and the Mining Engineer. By A. Nelson. *Mine and Quarry Engng.*, 1946, **11**, No. 3, 59-62. The importance of the time factor in mine planning and the usefulness of graphical methods for promoting the progress of development schemes and new plant erections.

Mining, Gas and Chemical Engineering. *Careers for Men and Women Series, No.* 19. Pp. 64, 8½ × 5½. (London: Ministry of Labour and National Service, 1945.)

CONCENTRATION AND METALLURGY

(*See also under Metals and Non-Metals.*)

Rubber-Lined Pipe Resists Abrasion in Mill Circuits. By J. Casale. *Engng. Min. J.*, 1945, **146**, No. 12, 100-101.

Ball Wear and Functioning of the Ball Load in a Fine-Grinding Ball Mill. By W. I. Garms and J. L. Stevens. *A.I.M.E. Tech. Pub. No.* 1984, 4 pp. *Min. Tech.*, 1946, **10**, No. 2.

Mining and Milling Operations of the South-western Graphite Co., Burnet County, Tex. By A. B. Needham. *Inform. Circ. No.* 7339, *U.S. Bur. Mines.* Pp. 9, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Crushing and Grinding Efficiencies. By T. K. Prentice. *Bull. Instn. Min. Metall., Lond.*, 1946, No. 477, 35 pp., with table and photographs.

Ore Concentration and Milling—Processing of Mineral Crudes Widens into Chemical Engineering Field. By E. H. Rose. *Min. and Metall.*, 1946, **27**, No. 470, 70-76.

Continuous Hydraulic Classification: Constitution of the Teeter Column throughout its Depth. By G. D. Coe, I. L. Field, M. F. Williams, Jr., and W. H. Coghill. *Rep. Invest. No.* 3851, *U.S. Bur. Mines.* Pp. 8, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Performance of a Hydraulic Classifier Designed to Incorporate Four Hitherto Neglected Principles. By W. H. Coghill, G. D. Coe, and I. L. Field. *Rep. Invest. No.* 3844, *U.S. Bur. Mines.* Pp. 13, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

A Study of Sizing Analysis by Sieving. By H. Heywood. *Bull. Instn. Min. Metall., Lond.*, 1946, No. 477, 18 pp.

Application of Sizing Analysis to Mill Practice. By H. Heywood and E. J. Pryor. *Bull. Instn. Min. Metall., Lond.*, 1946, No. 477, 10 pp., and table.

Disposal of Mill Tailings at the Holden [Washington] Concentrator. By V. A. Zanadvoroff. *A.I.M.E. Tech. Pub. No.* 1989, 8 pp. *Min. Tech.*, 1946, **10,** No. 2.

The Properties of Pine Oil Related to Flotation. By W. T. Bishop. *A.I.M.E. Tech. Pub. No.* 2011, 6 pp. *Min. Tech.*, 1946, **10,** No. 2.

Improving Flotation of Non-Sulphide Minerals. By A. M. Gaudin. *Engng. Min. J.*, 1945, **146,** No. 12, 91-95, 122.

Evaluation of some Binders for Use in Pelletizing Slimes. By T. A. Klinefelter. *Rep. Invest. No.* 3846, *U.S. Bur. Mines.* Pp. 13, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

The Local Treatment of Flotation Concentrates in the Transvaal, South Africa. By D. D. Stitt and N. B. Locke. *J. Chem. Metall. Min. Soc. S. Afr.*, 1945, **46,** Nos. 5 and 6, 138-159.

A Rapid Polarographic Method for the Determination of Copper, Zinc, and Lead in Flotation Tailings. By G. A. Crowe and W. T. Bishop. *A.I.M.E. Tech. Pub. No.* 2010, 8 pp. *Min. Tech.*, 1946, **10,** No. 2.

Hazards from Chlorates and Perchlorates in Mixtures with Reducing Materials. By I. Kabik. *Inform. Circ. No.* 7340, *U.S. Bur. Mines.* Pp. 6, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

METALS

Aluminium and Bauxite

Pilot-Plant Investigations—Preparation of Alumina from Potassium Alum. By C. T. Baroch, A. W. Hackwood and R. G. Knickerbocker. *Rep. Invest. No.* 3845, *U.S. Bur. Mines.* Pp. 26, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Alumina Produced from Northwest Clay. By J. R. Callaham. *Chem. Metall. Engng.*, 1945, **52,** No. 12, 108-109.

A Portable Differential Thermal Analysis Unit for Bauxite Exploration. By S. B. Hendricks, S. S. Goldich and R. A. Nelson. *Econ. Geol.*, 1946, **41,** No. 1, 64-76.

The Aluminium Products Industry [in Canada], 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 5, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1946.) Price 15 cents.

Bismuth

Bismutita y su Variedad Telurífera. By L. Blas. *Ion*, 1945, **5,** No. 53, 743-745. [In Spanish.]

Chromium

Selective Reduction of Iron in Chromite by Methane-Hydrogen and Similar Gas Mixtures. By F. S. Boericke. *Rep. Invest. No.* 3847, *U.S. Bur. Mines.* Pp. 14, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Le Chrome dans le Monde. By N. Demassieux. *Chimie et Industr.*, 1946, **55,** No. 1, 58-64. [In French.]

On the Chrome-Magnetite Deposit in the Vicinity of Lake Ishkul (Ilmen Mts.). By A. I. Simonov. *Mém. Soc. Russe Minéral., 2ième Série*, 1945, **74,** No. 4, 305-312. [In Russian with English summary.]

Beneficiation of Montana Chromite Concentrates by Roasting and Leaching. By R. R. Lloyd, O. C. Garst, W. T. Rawles and others. *Rep. Invest. No.* 3834, *U.S. Bur. Mines.* Pp. 37, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Gîtes de Chromite des Régions de Fethiye et de Dağardi (Turquie). By

V. Kovenko. *Maden Tetkik ve Arama*, 1945, **10**, No. 1/33, 42-75, with maps and photographs. [In Turkish and French.]

Filons de Chromite du Type d'Injection de la Région de Bursa (Turquie). By V. Kovenko. *Maden Tetkik ve Arama*, 1945, **10**, No. 2/34, 343-353. [In Turkish and French.]

Cobalt

A Study of Certain Factors in the Hydrometallurgy and Electrodeposition of Cobalt. By F. K. Shelton, R. E. Churchward, J. C. Stahl and G. F. Livingston. *Rep. Invest. No.* 3832, *U.S. Bur. Mines*. Pp. 43, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Metallurgical Treatment of Cobalt Ores from the Goodsprings Mining District, Nevada. By F. K. Shelton. *Rep. Invest. No.* 3836, *U.S. Bur. Mines*. Pp. 34, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Copper

Heats Contents above 25° C. of Seven Manganese-Copper Alloys. By B. F. Naylor. *Rep. Invest. No.* 3835, *U.S. Bur. Mines*. Pp. 13, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Copper Mining in the War Years—A Review of Rhokana Activities. By A. R. Harrison. *S. Afr. Min. Engng. J.*, 1946, **56**, Pt. 2, No. 2766, 603-607; No. 2767, 627-632.

Pine Vale Copper Mine, Mirani [Mackay District, Queensland]. By J. H. Reid. *Queensland Govt. Min. J.*, 1945, **46**, No. 530, 364.

Neuer Beitrag zur Kenntnis der Kupferlagerstaette " Ergani-Maden " in Vilâyet Elazig (Türkei). By P. de Wijkerslooth. *Maden Tetkik ve Arama*, 1945, **10**, No. 1/33, 76-104, and map. [In Turkish and German.]

Gold

Annual Bullion Review, 1945. Pp. 5, 9½ × 7. (London: Samuel Montague & Co., 1946.)

Notes on Assaying: 1.—Gold and Silver. By J. H. Harris. *Pamphlet No.* 9, *Geol. Div. Dep. Lds. Mines, Tanganyika*. Pp. 20, 9¾ × 6¾. (Dar-es-Salaam: Government Printer, 1945.) Price Cts. 75 (9*d*.).

Handbook of the West African Gold Mines. Compiled by H. Taylor, Pp. 110, 8½ × 5½. (London, New York, Melbourne, Sydney: Hutchinson's Scientific and Technical Publications, 1946.) Price 16*s*.

Gwanda Gold Belt. *Min. J.*, 1946, **226**, No. 5763, 81-82.

The Rand's Gold Industry—A Survey of 1945 Operations. *S. Afr. Min. Engng. J.*, 1946, **56**, Pt. 2, No. 2765, 573-577, 587.

Notes on the Aurora Goldfield, Cuyuni River, British Guiana. By S. Bracewell. *Min. Mag., Lond.*, 1946, **74**, No. 2, 82-87.

L. Mamen Group, Bee Lake, Red Lake Mining Division [Ontario]. By R. Thompson. *Precambrian*, 1946, **19**, No. 2, 7-8.

Lode-Gold Deposits [of British Columbia]. *Bull. No.* 20, *Dep. Mines, British Columbia*. Pt. II. South-eastern British Columbia. By W. H. Mathews. Pp. 19, 10½ × 7½, (1944). Pt. III. Central Southern British Columbia. By M. S. Hedley and K. De P. Watson. Pp. 27, 10½ × 7½, (1945). Pt. IV. South-western British Columbia. (Exclusive of Vancouver Island.) By J. S. Stevenson. Pp. 40, 10½ × 7½, (1944). Pt. V. Vancouver Island. By J. S. Stevenson. Pp. 29, 10½ × 7½, (1944). Pt. VI. North-eastern British Columbia and Cariboo and Hobson Creek Areas. By S. S. Holland. Pp. 16, 10½×7½, (1944). (Victoria, B.C.: King's Printer, 1944-5.)

The Mining Groups of the Yilgarn Goldfield, South of the Great Eastern Railway. By R. S. Matheson and R. A. Hobson. Part I. From Southern Cross Southwards to Marvel Loch. *Bull. No.* 98, *Geol. Surv. West. Austr.* Pp. 165 + vii, 8½ × 5½. Maps, Plans and Sections to accompany Part I, 24 plates, 13 × 8½. Part II. South of Marvel Loch. *Bull. No.* 99, *Geol. Surv. West. Austr.* Pp. 153 + vii, 8½ × 5½. Maps, Plans and Sections to accompany Part II, 27 plates, 13 × 8½. (Perth: Government Printer, 1940.)

The Fineness of Gold, with Special Reference to the Morobe Goldfield, New Guinea. By N. H. Fisher. *Econ. Geol.*, 1945, **40**, No. 7, 449-495; No. 8, 537-563.

L'Amalgamation des Minerais à Or Libre à Basse Teneur de la Mine du Mont Tsi. By R. Anthoine. *Mém. Inst. Roy. Colon. Belge*, (4° *Collection*), 1936, **2**, No. 1, 28 pp., 11½ × 9, and photographs. (Brussels: Librairie Falk fils, Georges van Campenhout, 1936.) [In French.]

Les Méthodes Pratiques d'Évaluation des Gîtes Secondaires Aurifères appliquées dans la Région de Kilo-Moto. By R. Anthoine. *Mém. Inst. Roy. Colon. Belge*, (4° *Collection*), 1941, **4**, No. 1, 218 pp., 11½ × 9. (Brussels: Librairie Falk fils, Georges van Campenhout, 1941.) [In French.]

Grands Traits de la Géologie et de la Minéralisation Aurifère des Régions de Kilo et de Moto (Congo Belge). By M. Legraye. *Mém. Inst. Roy. Colon. Belge*, (8° *Collection*), 1940, **2**, No. 3, 116 pp., 10 × 6½, with maps and photographs. (Brussels: Librairie Falk fils, Georges van Campenhout, 1940.) [In French.]

Les Gisements Auro-platinifères du Kivu (Province Orientale—Congo Belge). By G. Passau. *Bull. Séances Inst. Roy. Colon. Belge*, 1945, **16**, No. 1, 76-92. [In French.]

L'Incidence du Décret Minier de 1934 sur l'Exploitation Indigène des Gisements Aurifères de l'A.E.F. *Écho. Min. et Métall.*, 1946, No. 3368, 11-12. [In French.]

Mining Activity Renewed in Historic Eureka District [Nevada, U.S.A.]. By J. B. Huttl. *Engng. Min. J.*, 1945, **146**, No. 12, 88-90.

Iron and Steel

The Krupp-Renn Process—Continuous Reduction of Iron Ore. *Iron Coal Tr. Rev.*, 1946, **152**, No. 4072, 485-491.

Silicon Iron. Properties and Manufacture—An R.O.F. (Explosives) Memorandum. By J. E. Hurst and I. E. Braggs. *Industr. Chem. Chem. Mfr.*, 1945, **21**, No. 250, 606-612; No. 251, 649-654.

Electrolytic Manganese in Acid-Steel Tests at Atlas Steel Casting Co. and the Detroit Steel Casting Co. By R. T. C. Rasmussen. *Rep. Invest. No.* 3830, *U.S. Bur. Mines*. Pp. 20, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Manufacture of Sponge Iron in Periodic Brick Kilns. By K. M. Smith and S. E. Burton. *Rep. Invest. No.* 3841, *U.S. Bur. Mines*. Pp. 38, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Iron and Steel and their Products—Preliminary Summary Statistics, 1944 [Canada]. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 2, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1946.) Price 10 cents.

Prospecting for Iron Ore in Northwestern Ontario. By M. W. Bartley. *Precambrian*, 1946, **19**, No. 3, 7-9.

Mining and Geology at the Helen Mine [Michipicoten, Ontario]. By S. J. Kidder and G. C. McCartney. *A.I.M.E. Tech. Pub. No.* 1971, 24 pp. *Min. Tech.*, 1946, **10**, No. 2.

On the Chrome-Magnetite Deposit in the Vicinity of Lake Ishkul (Ilmen Mts.). By A. I. Simonov. *Mém. Soc. Russe Minéral.*, 2*ième Série*, 1945, **74**, No. 4, 305-312. [In Russian with English summary].

Rapid Specific-Gravity Method for Estimating the Iron Content of

Birmingham, Ala., Red Ores. By I. L. Field, G. D. Coe and W. H. Coghill. *Rep. Invest. No.* 3838, *U.S. Bur. Mines.* Pp. 6, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Exploration of Silver Hollow, Newbauer, and Coleman Iron Deposits, Franklin and Crawford Counties, Missouri. By K. L. Kreamalmyer. *Rep. Invest. No.* 3870, *U.S. Bur. Mines.* Pp. 10, 10½ × 8, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Lead and Zinc

The World's Lead Production—Keeping up with Heavier Consumption. *S. Afr. Min. Engng. J.*, 1946, **57**, Pt. 1, No. 2769, 35-37.

Polarographic and Spectrographic Analysis of High Purity Zinc and Zinc Alloys for Die Casting. *Ministry of Supply.* Pp. 117, 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 5*s*. An account of the Investigations carried out by a British Standards Institution Panel of the Non-Ferrous Industry Committee, 1941-44.

Electrolytic Refining of Lead. By W. H. Dennis. *Mine and Quarry Engng.*, 1946, **11**, No. 3, 55-58.

The Spinning of Zinc Ribbon, from Ingot Zinc, for Use in Extractor Boxes in the Reduction Works at Government Gold Mining Areas, Ltd. By J. C. Phillips. *J. Chem. Metall. Min. Soc. S. Afr.*, 1945, **46**, Nos. 3 and 4, 119-124.

Bringing into Production another Broken Hill Mine. *Chem. Engng. Min. Rev.*, 1946, **38**, No. 448, 133-135.

Mining Activity Renewed in Historic Eureka District [Nevada, U.S.A.]. By J. B. Huttl. *Engng. Min. J.*, 1945, **146**, No. 12, 88-90.

Manganese

Heats Contents above 25° C. of Seven Manganese-Copper Alloys. By B. F. Naylor. *Rep. Invest. No.* 3835, *U.S. Bur. Mines.* Pp. 13, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Electrolytic Manganese in Acid-Steel Tests at Atlas Steel Casting Co. and the Detroit Steel Casting Co. By R. T. C. Rasmussen. *Rep. Invest. No.* 3830, *U.S. Bur. Mines.* Pp. 20, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Concentration of Manganese Ores from Gila, Greenlee, and Graham Counties, Ariz. By G. M. Potter, A. O. Ipsen, and R. R. Wells. *Rep. Invest. No.* 3842, *U.S. Bur. Mines.* Pp. 12, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Mining and Concentration of Missouri Valley Manganese at Chamberlain, S. Dak. By L. W. Dupuy, W. A. Calhoun, and R. T. C. Rasmussen. *Rep. Invest. No.* 3839, *U.S. Bur. Mines.* Pp. 103, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Concentration of Oxide Manganese Ores from Clallam County, Wash. (Madeline, Lakeview, and Victory Claims.) By T. F. Mitchell and W. J. Long. *Rep. Invest. No.* 3837, *U.S. Bur. Mines.* Pp. 6, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Platinum Metals

Les Gisements Auro-platinifères du Kivu (Province Orientale—Congo Belge). By G. Passau. *Bull. Séances Inst. Roy. Colon. Belge*, 1945, **16**, No. 1, 76-92. [In French].

Radium Minerals

Radio Active Substances—Research on the Witwatersrand. *S. Afr. Min. Engng. J.*, 1946, **56**, Pt. 2, No. 2764, 565-566.

Silver

Notes on Assaying: 1.—Gold and Silver. By J. H. Harris. *Pamphlet No. 9, Geol. Div. Dep. Lds. Mines, Tanganyika.* Pp. 20, 9¾ × 6¼. (Dar-es-Salaam: Government Printer, 1945.) Price Cts. 75 (9*d*.).

The Treatment of Silver Ores. By F. B. Michell. *Mine and Quarry Engng.*, 1946, **11**, No. 4, 81-86.

Summary Review of the Silver Mining Industry in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 33, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1945.) Price 25 cents.

Mining Activity Renewed in Historic Eureka District [Nevada, U.S.A.]. By J. B. Huttl. *Engng. Min. J.*, 1945, **146**, No. 12, 88-90.

Tantalum

Tantalite and Tantalum. By J. H. Hohnen. *Min. Mag., Lond.*, 1946, **74**, No. 2, 77-82. Discussion of future utilisation.

Tin

The Tin Research Institute, 1942-1944. Pp. 32, 9¾ × 6. (Greenford, Middlesex: Tin Research Institute, 1945.)

The Dressing of Tin Ores. By F. B. Michell. *Mine and Quarry Engng.*, 1945, **10**, No. 12, 289-296, 300-301; 1946, **11**, No. 1, 15-19; No. 2, 29-36.

A Survey of the Deeper Tin Zones in a Part of the Carn Brea Area, Cornwall. By B. Llewellyn. *Bull. Instn. Min. Metall., Lond.*, 1946, No. 477, 19 pp., with table and map.

Tungsten

A Review of Fluorescence as Applied to Minerals, with Special Reference to Scheelite. By J. W. Vanderwilt. *A.I.M.E. Tech. Pub. No.* 1967, 14 pp. *Min. Tech.*, 1946, **10**, No. 2.

Uranium

The Chemical and Radioactive Properties of the Heavy Elements. By G. T. Seaborg. *Industr. Engng. Chem.* (*News Ed.*), 1945, **23**, No. 23, 2190-2193.

Le Gîte d'Uranium de Shinkolobwe-Kasolo (Katanga). By J. Thoreau and R. du Trieu de Terdonck. *Mém. Inst. Roy. Colon. Belge,* (4° *Collection*), 1933, **2**, No. 1, 46 pp., 11½ × 9, and photographs. (Brussels: Libraire Falk fils, Georges van Campenhout, 1933.) [In French.]

NON-METALS

Miscellaneous Non-Metallic Minerals

Nonmetallic Industrial Minerals—Backlog of Requirements in Construction Industry, plus Agricultural Requirements, Assure Prosperity [in U.S.A.]. By O. Bowles. *Min. and Metall.*, 1946, **27**, No. 470, 77-82.

Asbestos

Milling Asbestos. By J. C. Kelleher. Pp. 16, 7½ × 5. [Reprint of a series of articles appearing in *Asbestos*.] (Philadelphia, Pa: *Asbestos*, January, 1946.) Price 25 cents.

Building Materials

Sand and Gravel; A Description of a Plant on the River Ribble, Lancashire. By A. Bray. *Mine and Quarry Engng.*, 1946, **11**, No. 2, 44-45, 36.

The Manufacture of Roofing Tiles in East Africa. By H. O. Weller. *Tech. Pamphlet No.* 12, *E. Afr. Industr. Res. Bd.* Pp. 15, 9½ × 6½. (Nairobi: East African Industrial Research Board, 1945.) Price 75 cents.

Building Limes. By H. O. Weller. *Tech. Pamphlet No.* 13, *E. Afr. Industr. Res. Bd.* Pp. 8, 9¾ × 6. (Nairobi: East African Industrial Research Board, 1946.) Price 50 cents.

The Cement Manufacturing Industry in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 11, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1945.) Price 25 cents.

Asphaltic Road Oils from Alberta Bituminous Sand. By K. A. Clark. *Contribution No.* 8, 1945, *Res. Counc. Alberta.* Pp. 2, 11 × 8½. Reprinted from *Canad. Chem. Proc. Industr.*, Sept., 1945.

Sweden's Modern Cement Plant [Skanska Cement Co., Koping, Sweden]. By B. Nordberg. *Rock Prod.*, 1946, **49**, No. 1, 78-83.

Rock Products Industry on the West Coast [U.S.A.]. By B. Nordberg. *Rock Prod.*, 1945, **48**, No. 12, 76-80, 134, 136.

Operating Trends in the Rock Products Industry. By H. E. Swanson and N. C. Rockwood. *Rock Prod.*, 1945, **48**, No. 11, 71-75, 78-83, with geological maps. [Article deals with Michigan, U.S.A.].

Operating Trends in the Rock Products Industry—Wisconsin Geological Factors in its Favour. By H. E. Swanson and N. C. Rockwood. *Rock Prod.*, 1945, **48**, No. 12, 106-118, with maps.

Chemical Products

The Heavy Chemical Industry in 1945. By P. Parrish. *Chem. Age*, 1946, **54**, No. 1385, 33-52.

Calcium Carbide in South Wales; a Wartime Development. *Industr. Chem. Chem. Mfr.*, 1945, **21**, No. 251, 655-662; 1946, **22**, No. 252, 24-31.

Ammonium Sulphate [in Canada], 1945. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 2, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1946.) Price 25 cents.

China Clay

The Chinaclay Industry in Malnad [India]. *Asiat.* (*Quart.*) *Rev.*, 1946, **42**, No. 149, 76-78.

Scope for Developing China Clay Industry in Malnad. By B. N. Raghunatha Rao. *Pop. Stud. No.* 4, *Mysore Geol. Dep.* Pp. 9, 9½ × 5¾, and map. (Bangalore: Superintendent at Government Press, 1945.) Price 8 annas.

Clay and Ceramics

Ceramic Report for the 3 months ending March 31st, 1946. *Memo. No. RB* (*NS*) **13**, *E. Afr. Industr. Res. Bd.* Pp. 2, 13 × 8½. (Nairobi: East African Industrial Research Board, 1946).

Report of Committee on Geological Surveys for 1944-1945. *Bull. Amer. Ceram. Soc.*, 1946, **25**, No. 1, 10-13.

Molecular Associations between Montmorillonite and some Polyfunctional Organic Liquids. By W. F. Bradley. *Rep. Invest. No.* 108, *Illinois State Geol. Surv.* Pp. 13, 9¾ × 6¾. (Urbana, Illinois: State Geological Survey Division, 1945.) Reprinted from *J. Amer. Chem. Soc.*, 1945, **67**, No. 6.

Clay Research and Oil Development Problems. By J. C. Griffiths. *J. Inst. Petrol.*, 1946, **32**, No. 265, 18-31.

La Bentonite: ses Propriétés et ses Applications. By F. Gruber. *Bull. Mat. Grasses*, 1941, **25**, No. 6, 91-97. [In French.]

Report on Testing of Upper Yarraman Bentonite. By N. H. Fisher. *Rep. No.* 1944/49, *Min. Res. Surv., Dep. Supply and Shipping, Austr.* Pp. 7 + 5, 13½ × 8½, and maps. (Canberra: Commonwealth Government Printer, December, 1944.)

Illinois Surface Clays as Bonding Clays for Molding Sands. By R. M. Grogan and J. E. Lamar. *Rep. Invest. No.* 104, *Illinois State Geol. Surv.* Pp. 41, 9¼ × 6¼. (Urbana, Illinois: State Geological Survey Division, 1945.)

Prospecting for and Testing of Clay Samples from Missouri Fire-Clay Deposits. By L. E. Puntney. *Bull. Amer. Ceram. Soc.*, 1945, **24**, No. 12, 448-450.

Coal, etc.

A Graphical Form for Applying the Rosin and Rammler Equation to the Size Distribution of Broken Coal. By W. S. Landers and W. T. Reid. *Inform. Circ. No.* 7346, *U.S. Bur. Mines.* Pp. 5, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Burning Bituminous and Subbituminous Coals on an Anthacite, Ash-Removal Type, Domestic Stoker. By H. F. Yancey and K. A. Johnson. *Rep. Invest. No.* 3849, *U.S. Bur. Mines.* Pp. 14, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Coal Industry Nationalisation. *Ministry of Fuel and Power.* Pp. 3, 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 1*d.*

The Gas Industry—Report of the Committee of Enquiry. *Ministry of Fuel and Power.* Pp. 57, 9½ × 6, and maps. (London: H.M. Stationery Office, 1945.) Price 2*s.*

A Plan for Cheap Gas. By R. Maclaurin. *Bull. No.* 9, *Scottish Reconstruction Committee.* Pp. 12, 8½ × 5½. (Glasgow: Scottish Reconstruction Committee, 1945.) Price 6*d.*

Britain's Coal Crisis and Opportunity. By W. Wakefield Adam. *Bull. No.* 8, *Scottish Reconstruction Committee.* Pp. 8, 8½ × 5½. (Glasgow: Scottish Reconstruction Committee, 1945.) Reprinted from an address to the Institute of Export, September, 1945.

The Microspores in the Coal-Seams of North Staffordshire—The Seams of the Cheadle Coalfield. By J. O'N. Millott. *Trans. Instn. Min. Engrs., Lond.*, 1945, **105**, Pt. 2, 91-102.

The Correlation of the Coal Measures of the Cheadle Coalfield, North Staffordshire. By F. Wolverson Cope. *Trans. Instn. Min. Engrs., Lond.*, 1945, **105**, Pt. 2, 75-91, and map.

Colliery Modernisation, with special Reference to the Fife Coal Company's Collieries. By H. R. King. *Trans. Instn. Min. Engrs., Lond.*, 1945, **104**, Pt. 11, 634-663, and plates.

A Preliminary Note on the Waterberg Coalfield as a Possible Source of Coking Coal. By P. E. Hall. *J. Chem. Metall. Min. Soc. S. Afr.*, 1945, **46**, Nos. 3 and 4, 124-132.

Coal Statistics for Canada for the Calendar Year 1943. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 104, 9¾ × 6½. (Ottawa: King's Printer, 1946.) Price 50 cents.

The Compressed Gases Industry [in Canada], 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 6, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1945.) Price 15 cents.

Research and the Coal Industry in Canada. By W. A. Lang. *Canad. Min. Metall. Bull.* (*Trans. Sec.*), 1946, No. 406, 51-62.

Baralaba Coalfield [Dawson River, Queensland]. By J. H. Reid. *Queensland Govt. Min. J.*, 1945, **46**, No. 530, 354-363.

Le Charbon de la Sarre. *Écho Min. Métall.*, 1946, No. 3368, 5. [In French.]

Ruhr Coal Mining. By J. T. Whetton. *Iron Coal Tr. Rev.*, 1946, **152**, No. 4068, 287-295.

American Commentary. By F. S. Atkinson, J. Halford, D. J. C. Macaskill and others. *Trans. Instn. Min. Engrs., Lond.*, 1945, **105**, Pt. 1, 25-47, and map.

American Mining Commentary—Impressions of a Recent Visit to the

Bituminous Coalfields of the United States. By R. Neill. *Iron Coal Tr. Rev.*, 1946, **152**, No. 4075, 615-619; No. 4076, 663-667.

Washability Characteristics and Washing of Coals from the Matanuska Field of Alaska. By M. R. Geer and H. F. Yancey. *Rep. Invest. No.* 3840, *U.S. Bur. Mines.* Pp. 17, $10\frac{1}{2} \times 8$. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Coke from Illinois Coals—an Experimental Slot-Type Oven. By F. H. Reed, H. W. Jackman and P. W. Henline. *Rep. Invest. No.* 107, *Illinois State Geol. Surv.* Pp. 18, $9\frac{3}{4} \times 6\frac{3}{4}$. (Urbana, Illinois: State Geological Survey Division, 1945.) Reprinted from *Industr. Engng. Chem.*, 1945, **37**, No. 6.

Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944. By M. A. Elliott, C. W. Siebel and others. *Rep. Invest. No.* 3867, *U.S. Bur. Mines.* Pp. 44, $10\frac{1}{2} \times 8$. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Possibilités géologiques de l'Extension du Bassin Houiller d'Ereğli-Zonguldak. By N. Egeran. *Maden Tetkik ve Arama*, 1945, **10**, No. 2/34, 364-371. [In Turkish and French.]

Coal Mining in Russia—Opening up New Soviet Coal Fields. By A. Beloborodov. *S. Afr. Min. Engng. J.*, 1946, **56**, Pt. 2, No. 2761, 495.

Diamonds

Industrial Diamond Development in England in 1945. Pp. 6 + iv, 10×8. (London: Diamond Trading Company Limited, Diamond Research Department, 1946.)

Felspar

The Raw Materials of Scotland—Alkali Felspar and Other Sources of Potash in Scotland. By A. Lamont and R. H. S. Robertson. *Bull. No.* 2, *Scottish Reconstruction Committee.* Pp. 7, $8\frac{1}{2} \times 5\frac{1}{2}$. (Glasgow: Scottish Reconstruction Committee, 1944.) Price 2*d.* Reprinted from *The Quarry Managers' Journal*, December 1943.

Fluorspar

Fluorspar. [Australian market specifications, grade, size, etc.] *Queensland Govt. Min. J.*, 1945, **46**, No. 529, 313-314.

Fluorspar Deposits. Emuford, Almaden and Chillagoe Districts. By J. E. Ridgway. *Queensland Govt. Min. J.*, 1945, **46**, No. 529, 326-333.

Gemstones

Chemical Tests for Paste and Quartz. By M. D. S. Lewis. *Gemmologist*, 1946, **15**, No. 175, 37-38.

South African Emeralds—Mining Operations to be Expanded. *S. Afr. Min. Engng. J.*, 1946, **57**, Pt. 1, No. 2770, 59-61.

Les Gisements de Jais en Turquie. By E. Lahn. *Maden Tetkik ve Arama*, 1945, **10**, No. 1/33, 109-114. [In Turkish and French.]

Lime and Limestone

Impact Primary Produces Cubical Products [at McCorkle Stone Co., Milroy, Ind.]. By R. S. Torgerson. *Rock Prod.*, 1945, **48**, No. 11, 66-67, 87.

Building Limes. By H. O. Weller. *Tech. Pamphlet No.* 13, *E. Afr. Industr. Res. Bd.* Pp. 8, $9\frac{3}{4} \times 6$. (Nairobi: East African Industrial Research Board, 1946.) Price 50 cents.

The Lime Industry in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 9, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1946.) Price 25 cents.

Magnesite

Magnesite—Brazil to Work Vast Deposits. By J. A. Merz. *Rock Prod.*, 1945, **48**, No. 11, 92-94.

Mica

Some Physical Properties of Mica. By P. Hidnert and G. Dixon. *J. Res. Nat. Bur. Stand., Wash.*, 1945, **35**, No. 4, 309-353.

Color Standard for Ruby Mica. By D. B. Judd. *J. Res. Nat. Bur. Stand., Wash.*, 1945, **35**, No. 4, 245-256.

Mica in the Western Highlands, Scotland. By A. A. C. Dickson. *Min. World, Lond.*, 1946, **150**, No. 3911, 147-148.

Petroleum, etc.

International Petroleum Trade. *Int. Petrol. Tr.*, **14**, No. 9, *U.S. Bur. Mines.* Pp. 17, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

International Petroleum Trade. *Int. Petrol. Tr.*, **14**, No. 10, *U.S. Bur. Mines.* Pp. 24, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

What's New in Oil Industry Equipment. *World Petrol.*, 1945, **16**, No. 5, 39-69.

Catalytic Cracking adapted to Smaller Refineries. *World Petrol.*, 1945, **16**, No. 12, 76-77.

Clay Research and Oil Development Problems. By J. C. Griffiths. *J. Inst. Petrol.*, 1946, **32**, No. 265, 18-31.

Pure Hydrocarbons from Petroleum. By J. Griswold and C. F. Van Berg. *Industr. Engng. Chem.* (*Industr. Ed.*), 1946, **38**, No. 2, 170-177. Composition and separation of a straight-run heptane fraction by the Distex process.

Advances in Oilfield Drilling Material and Practice; American Wartime Developments Reviewed. By R. B. Rogers. *Petrol. Times*, 1946, **50**, No. 1266, 109-110.

Diesel Engines for Oil Field Drilling. By H. F. Shepherd. *World Petrol.*, 1945, **16**, No. 3, 40-42.

Petroleum Byproducts. By B. H. Weil. *Chem. Metall. Engng.*, 1945, **52**, No. 12, 121-128.

New Moves in Secondary Recovery. By O. W. Willcox. *World Petrol.*, 1945, **16**, No. 3, 50-53.

United Kingdom: S.R. and O. No. 1648. The Hydrocarbon Oils Regulations, 1945. *Commissioners of Customs and Excise.* [Reprint] *Petrol. Times*, 1946, **50**, No. 1266, 123-125.

Report of the Hydrocarbon Oil Duties Committee. Pp. 15, 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 3*d*.

Some Problems Encountered during Well Shooting Operations in the Nottinghamshire Oilfields. By J. F. Waters. *J. Inst. Petrol.*, 1946, **32**, No. 267, 119-126.

The Crude Petroleum Industry in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 12, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1946.) Price 25 cents.

Canadian Oil Search Turns to New Areas. By H. G. Cochrane. *World Petrol.*, 1944, **15**, No. 9, 30-33.

Petroleum in 1944. By R. B. Harkness. *Ann. Rep. Ontario Dep. Mines*, 1945, **54**, Pt. 3, 74-79.

Natural Gas in 1944. By R. B. Harkness. *Ann. Rep. Ontario Dep. Mines*, 1945, **54**, Pt. 3, 1-73.

Bituminous Sands of Alberta. By K. A. Clark. *Contribution No.* 7, 1945, *Res. Counc. Alberta*. Pp. 6, 11 × 8½. Reprinted from *Oil Wkly.*, Aug. 13, 1945.

Alberta Oil Development. Half-yearly Review for 1945. By J. L. Irwin. *Dep. Lds. Mines*. Pp. 6, 13 × 8. (Edmonton: King's Printer, 1945.)

Widespread Search for Oil and Gas in Saskatchewan, 1945. By J. L. Phelps. *Precambrian*, 1946, **19**, No. 1, 25-27.

Report together with Minutes of Evidence relating to the Baerami Shale Oil Proposal. *Parliamentary Standing Committee on Public Works, Commonwealth of Australia*. Pp. 75, 13½ × 8½. (Canberra: Government Printer, 1945.) Price 3*s*. 4*d*.

Les Graben Africains et La Recherche du Pétrole en Afrique Orientale. By G. de Grand Ry. *Mém. Inst. Roy. Colon. Belge*, (4° *Collection*), 1941, **4**, No. 2, 76 pp., 11½ × 9. (Brussels: Librairie Falk fils, Georges van Campenhout, 1941.) [In French.]

U.S. Reserves gained 389,000,000 Barrels in 1944. [Summary of report by the Committee on Reserves of the American Petroleum Institute.] *World Petrol.*, 1945, **16**, No. 4, 58-60.

Geologic Surveys are Planned for Continental Shelf [U.S.A.]. *World Petrol.*, 1945, **16**, No. 12, 65.

National Motor-Gasoline Survey, Summer, 1945. By O. C. Blade. *Rep. Invest. No.* 3883, *U.S. Bur. Mines*. Pp. 34, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

The Petroleum Industry [in U.S.A. in 1945]. By M. L. Haider and others. *Min. and Metall.*, 1946, **27**, No. 470, 115-124.

Exploratory Drilling in 1944 [in U.S.A.]. By F. H. Lahee. *World Petrol.*, 1945, **16**, No. 6, 56-58.

Progress of Oil Development in Southeastern Gulf Coast States. By S. Lloyd, W. C. Morse, G. Peyton and H. Gunter. *World Petrol.*, 1945, **16**, No. 2, 52-57.

California Deep Well Test Exceeds Three Mile Depth. *World Petrol.*, 1945, **16**, No. 2, 42-48. Ordinary drilling equipment carried world's deepest bore to 16,246 feet without serious difficulty or interruption.

California's Exploration Covers Wide Range. By N. A. D'Arcy, Jr. *World Petrol.*, 1944, **15**, No. 9, 24-28.

Selected Well Logs of Colorado. By C. F. Barb. *Colo. Sch. Mines Quart.*, 1946, **41**, No. 1, pp. 435, and map.

Developments in Eastern Interior Basin in 1944. By A. H. Bell. *Illinois Petrol. No.* 51. Pp. 8, 9¾ × 6¾. (Urbana, Illinois: State Geological Survey, 1945.) Reprinted from *Bull. Amer. Assoc. Petrol. Geol.*, 1945, **29**, No. 6, 685-692.

Oil and Gas Development in Illinois in 1944. By A. H. Bell and V. Kline. *Illinois Petrol. No.* 52. Pp. 43, 9¾ × 6¾. (Urbana, Illinois: State Geological Survey, 1945.) Reprinted from *Trans. Amer. Inst. Min. Metall. Engrs.*, 1945, **160**, 293-334.

Lake Creek Field [Montgomery, Texas]—An Example of State Conservation. By B. H. Jester and J. K. Baumel. *World Petrol.*, 1945, **16**, No. 9, 52-56, 72.

Oil Titles in Latin America. By H. V. B. Tompkins. *World Petrol.*, 1946, **17**, No. 1, 54-55 [Exclusive of British, French and Dutch possessions].

Search for Oil in the Chaco. *World Petrol.*, 1945, **16**, No. 2, 38-39.

Brazil has Four Oil Fields with 25 Producing Wells. By A. I. de Oliveira. *World Petrol.*, 1945, **16**, No. 10, 74-75.

Results of Oil Exploration in Colombia. By E. Ospina-Racines. *World Petrol.*, 1945, **16**, No. 4, 52-53.

Petroleum Activities in Venezuela. By A. Reyes. *World Petrol.*, 1945, **16**, No. 10, 78-80.

Thrace and Oil. By C. E. Tamşan. *Maden Tetkik ve Arama*, 1945, **10**, No. 2/34, 336-342. [In Turkish with English summary.]

Phosphates

Phosphate Philosophy. By A. R. Maas. *Chem. Metall. Engng.*, 1945, **52**, No. 12, 112-114.

Utlåtande Angående Uppförande av en Superfosfat-fabrik i Lulea. *Kommers. Meddel.*, 1946, **33**, No. 2, 94-96. [In Swedish.].

Potash

The Raw Materials of Scotland — Alkali Felspar and Other Sources of Potash in Scotland. By A. Lamont and R. H. S. Robertson. *Bull. No.* 2, *Scottish Reconstruction Committee.* Pp. 7, 8½ × 5½. (Glasgow: Scottish Reconstruction Committee, 1944.) Price 2d. Reprinted from *The Quarry Managers' Journal*, December, 1943.

Quartz

Deposits of Quartz Crystal in Espirito Santo and Eastern Minas Gerais, Brazil. By F. L. Knouse. *A.I.M.E. Tech. Pub. No.* 1962, 12 pp. *Min. Tech.*, 1946, **10**, No. 2.

Refractories

Statistical Data Relative to the Firing Expansion, Specific Gravity and After-Expansion of Silica Bricks. *Trans. Brit. Ceram. Soc.*, 1945, **44**, No. 10, 167-206, with discussion.

Rock Wool

Rock Wool. By E. M. Guppy and J. Phemister. *Mem. Geol. Surv., Spec. Reps. Miner. Res. Gt. Britain*, **34**, 46 pp., 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 9*d*.

Salt

Salt—Its Sources and Supplies in India. By K. H. Vakil. Pp. 54, 8½ × 5½. (Fort, Bombay: Commercial Printing Press, 1945.) Price Rupees 2/8.

Sulphur

Italy's Sulphur Industry. By C. A. Botsford. [Abstract]. *Foreign Comm. Wkly.*, 1946, **22**, No. 3, 12-13.

Talc

The Talc and Soapstone Industry [in Canada], 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 7, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1945.) Price 15 cents.

Water Power and Supply

Constructional Scheme No. 3. North of Scotland Hydro-Electric Board. *Scottish Home Dep.* Pp. 3, 9½ × 6. (Edinburgh: H.M. Stationery Office, 1945.) Price 1*d*.

The Design, Construction, and Operation of a Water-Treatment Plant at Mufulira Mine, Northern Rhodesia. By K. Paterson. *J. Instn. Civil Engrs.*, 1946, **25**, No. 4, 281-300, and diagrams.

Search for Power in the British Columbia Coast Range. By R. C. Farrow. *Geogr. J.*, 1945, **106**, Nos. 3 and 4, 89-117.

Proposed Extension of the Water-Supply of Bombay. By C. Inglis. *J. Instn. Engrs. India*, 1945, **26**, No. 2, Pt. 1, 22-28.

The First All-Palestine Conference of the Section of Water Engineers. *J. Ass. Engrs. Archits. Palestine*, 1946, **7**, 17-31. [Abstracts from papers dealing with water supply.]

Zircon

Survey of Literature on the Metallurgy of Zirconium. By W. J. Kroll and A. W. Schlechten. *Inform. Circ. No.* 7341, *U.S. Bur. Mines.* Pp. 50, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Zirconium in Industry—A Review of Recent Developments. By M. Schofield. *Industr. Chem. Chem. Mfr.*, 1945, **21**, No. 251, 641-643.

Development of Zircon as a Versatile Ceramic Material. By N. R. Thielke and H. W. Jamison. *Bull. Amer. Ceram. Soc.*, 1945, **24**, No. 12, 452-456.

EMPIRE EDUCATIONAL FACILITIES

EXHIBITION GALLERIES, LANTERN SLIDES, FILMS, LECTURES, Etc.

NOTES

Exhibition Galleries.—Staff shortages due to the war and its aftermath have still made it impossible to revert to pre-war times of opening and closing the Exhibition Galleries to the general public during the six months under review. From 1st July, however, the Galleries have been open daily, as pre-war, from 10 a.m. to 4.30 p.m. with a 45-minute showing of Empire Films in the Cinema Theatre, starting at 3.30 p.m.

Attendances.—Attendances have been excellent during the half-year under review—January to June, 1946. There have been 262 organised parties totalling 7,349 persons, and in addition the Galleries have been visited by 29,718 members of the general public. The Galleries achieved a wartime and post-war record on February 25, 1946, when there were 1,379 visitors.

A Hint for Schools.—One Senior Girls' School hit on an extremely useful method of making the Galleries of real value without the aid of a Guide Lecturer. The Geography Mistress, who knew the Galleries, had written out a number of questions to which the answers were to be found in the Exhibition Galleries. Her class was then divided into pairs, each pair was given two or three questions, and they spent the afternoon seeking out and writing down the answers. The girls, though regarding it as somewhat of a game, should remember much of what they found out.

Labelling.—An important task which had perforce to be left undone during the war has now been completed. This entailed the labelling of several score of new exhibits, specimens, and photographs and the substitution in very many cases of permanent printed labels for those which had previously only been written by hand. There was an accumulation of several hundred of these, attached to exhibits received just before and during the war, and the correct labelling and the incorporation of brief references to the uses, etc., of each exhibit entailed a very considerable amount of

research. The result can perhaps best be seen in the three show-cases of fruit in the South African Court, now fully labelled, where previously there had been no labels at all.

It is also intended in course of time to re-label a very large number of the exhibits in order to make them more informative. Specimens, for example, of the ores of zinc and antimony with only their names against them convey little information except as to the appearances of the ores, which to the untrained eye are often very similar. When, however—as has already been done in the Canadian Court—the labels read "Zinc—for galvanising iron" and "Antimony—for printers' type" the value of the label and specimen is enormously increased. This system is being gradually adopted throughout the Galleries but it will be some time before the work can be completed.

Inset Maps.—In each of the principal Courts of the Galleries is a large relief map of the portion of the Empire to whose industries, products, and people that particular Court is devoted. These maps are extremely useful for showing the configuration of the country, positions of towns, districts, rivers, lakes, and so on; but hitherto there have been no ready means of showing the position of the country, territory, or island concerned in relation to the rest of the world. This has now been put right by inserting under the glass cover of each relief map a small map of the world (Mercator's projection) with British Empire countries in colour and the area embraced by the relief map either outlined or indicated by an arrow. The value of the relief maps has thereby been greatly increased.

New Exhibits.—The war has not been over long enough for any new large-scale exhibits to reach the Galleries, but two dioramas showing the Ananda Temple in Burma and the Taj Mahal in India are in course of construction. A special display of elephant photographs and of the many uses of ivory is in preparation and a new type of "dissolving picture", peculiarly suitable for showing scenes of the "before and after" type, should soon make its appearance in the Galleries. A statuette of Henry Hudson, the famous navigator, has been commissioned and will be placed in the Canadian Court in a few weeks' time.

Indian Minerals.—The display of Indian minerals in the Indian Court has been practically completed and when finished will contain specimens of twenty-six of India's most important mineral products. Where applicable, examples or models of finished articles, of which the mineral in question is the sole or an important ingredient, will be shown.

West Indian Cocoa.—In the case opposite the diorama of a West Indian Cocoa Plantation full-sized models of cocoa pods have been substituted for the glass jars which previously contained actual pods preserved in spirit. These new models of course reproduce the varied natural colours of the pods much more strikingly than the bottled specimens which tend to change to an ugly brown.

The receipt from Cadbury Brothers of several new photographs of processes in the preparation and packing of both cocoa and chocolate has provided an opportunity for re-arranging the whole of the West Indian Cocoa exhibit. This display is now much more complete. The incorporation in the individual labels of the information, hitherto given in a 500-word label at one side of the case, enables the visitor to follow with extreme lucidity the whole story of West Indian cocoa from the tree and its products and its initial discovery, through every detail of processing to the finished cocoa and chocolate ready for consumption.

Model of a Palestine Schooner.—An attractive addition to the Palestine Court is a very fine model of a Palestine Arab schooner lent to the Galleries by Captain C. H. Rolleston, R.N. (Retired). This model, which was made in Palestine, is complete in every detail and the following "story" has been placed alongside it:

> "The coastal Arab is a fine seaman and boat-building is a highly-developed industry in the Levant.
>
> "Craft of this type, which are not fishing vessels but cargo carriers, operate all over the Eastern Mediterranean, but are generally laid up during the winter. The fierce and sudden squalls which are characteristic of winter-time, especially off the Turkish coast, explain why the sails taper off towards the mast-head, thus keeping the centre of wind-pressure low and reducing the risk of capsizing.
>
> "These Palestine schooners—some capable of carrying 300 tons of cargo—as well as those of Syria, Lebanon, and Egypt were enormously useful during the Second World War. In one summer season alone craft such as this brought 14,000 tons of chrome ore from Turkey to Egypt and thereby made a corresponding amount of shipping space in ocean-going ships available for use elsewhere.
>
> "One evening in 1942 six of these schooners were sunk off Beirut by an Italian submarine in the space of half an hour, but others carried on and made a valuable contribution towards winning the war."

North Borneo Timbers.—In April, 1946, the British North Borneo Company kindly presented to the Institute a collection of

fifty sample pieces of North Borneo Timbers, which make an interesting and informative addition to the Galleries.

Gifts by Her Majesty Queen Mary.—Two most generous and interesting gifts were made to the Exhibition Galleries by Her Majesty Queen Mary in April, 1946.

The first of these is an ivory casket containing eighteen of the first diamonds, both commercial stones and gem stones, found in Sierra Leone between 1931 and 1933. These were originally presented to His Royal Highness The Duke of Windsor when he visited West Africa as Prince of Wales. Through Queen Mary's kindness they have now found their final home in the West African Court.

The other gift consists of twelve most attractive ostrich feathers which were given to Her Royal Highness The Princess Royal in 1913. They include body feathers, tail feathers, female wing feathers, and feathers from an ostrich chick. They are really beautiful and make a most handsome addition to the Australian Court.

Resident Artist.—In order to cope with the accumulation of repair and re-touching work in connection with dioramas, and to carry out experimental work and renovate models and other exhibits, which had suffered from a certain amount of enforced neglect due to lack of staff during the war, it was decided to add a Resident Artist to the staff of the Galleries. Mr. A. J. Carter, A.R.C.A., joined the Exhibition Galleries in that capacity on January 1, 1946.

Empire Lantern Slide Library.—During the six months, October 1945 to March 1946, covered by this report, 47,920 lantern slides have been issued to schools and lecturers in the United Kingdom. The details are shown below:

	Oct.	Nov.	Dec.	Jan.	Feb.	March.
United Kingdom	660	420	360	600	660	480
Canada	1,320	540	480	960	900	660
Australia	360	360	360	360	600	1,080
New Zealand	240	360	120	420	660	360
South Africa	360	240	300	600	240	420
India	960	1,740	480	1,560	820	1,080
Burma	840	240	240	300	60	560
The Colonial Empire	2,400	2,880	2,100	2,400	4,440	2,880
Products of the Colonial Empire	640	120	240	600	240	240
General Empire Tours	180	180	240	240	360	480
Empire History	900	960	180	360	180	120
	8,860	8,040	5,100	8,400	9,160	8,360

Mr. John Goepel, M.A., recently Political Officer in Aden, has supplied the pictures and written a talk on Aden Protectorate. The

introduction tells how Aden ceased to be a home for pirates and the story of its growth to a town of 60,000 inhabitants—in conditions of security—as part of the British Commonwealth. The port, strategically so well placed, is known chiefly for its usefulness to ships sailing to or from India and the Far East, but it also serves the needs of the inland territory of Aden Protectorate. Mr. Goepel describes the climate, religions, houses, palaces and occupations of the people of the Protectorate and their Sheikhs and Sultans. He illustrates the building and sailing of dhows, the camel transport system of the interior and the importance of the few roads in the administration of the country. The Arab gift for ornamentation, and what he can do with mud bricks and plaster in a very dry climate, are shewn in the buildings of Seiyun, Shibam and Mukalla. After describing the street trades of weaver, barber, blacksmith and merchant, the talk ends with pictures of the tribesmen and of Arab children.

Mr. W. E. Neal, Secretary to the Clove Growers' Association, has written a Picture Talk on "Zanzibar and Pemba," opening with pictures of Zanzibar City. The talk makes brief reference to the rule of the Protectorate under the Sultan, and of the religious outlook of the people, mostly Moslems. The educational facilities are shown in a series of pictures of Arab, African, and Indian children in a Zanzibar secondary school and in rural schools, and these are followed by a description of the hospitals and medical services available to the subjects of the Sultan, with due consideration for differences in race or creed. The administration of the Islands is illustrated by typical pictures of a District Commissioner on tour and in consultation with his local Mudirs, and of the Khadi presiding over the Mohammedan law court. Finally, the agricultural nature of the country is illustrated by pictures of coffee, rice, oranges, tobacco, and by a detailed series of slides of the important clove industry which has given the country its secondary title of the "Spice Islands."

Nine more Film Strips have been made from the Picture Talks, making a total of 25 in the Film Strip Library.

Central Film Library.—The circulation of films for the six months, November to April, is shown below:

	Empire.	G.P.O.	C.O.I.	Total.
November	3,230	561	5,761	9,552
December	2,308	419	4,820	7,547
January	2,865	495	4,746	8,106
February	3,336	569	5,299	9,204
March	3,298	585	5,747	9,630
April	1,610	325	3,890	5,825

If given reasonable notice the Library is able to meet practically all demands for sound films but the position in regard to 16 mm.

silent films is not so satisfactory. By mid-October all films of this type were fully booked until Christmas and by the beginning of February no further bookings could be taken for dates before Easter. Owing to the shortage of good silent films dealing with the Overseas Empire, it is not possible to remedy this.

Grants made by the Imperial Relations Trust and the Colonial Empire Marketing Board enabled the Library to purchase 330 prints of Dominion and Colonial films. These were mainly additional copies of films already in the Library and were required to replace films withdrawn because of wear, or to increase the stock of films in particularly heavy demand.

The Ministry of Information (now Central Office of Information) has placed many new Empire films in the Library. These include:

CANADA.

This Is Our Canada	A short survey of the country and its resources.

INDIA.

Palmyrah	An Indian tree from which an extraordinary range of products is derived.
District Officer	A day's work of a District Magistrate in Bengal.
Our Northern Cousins	Life and customs in a Punjab village.

COLONIAL EMPIRE.

Partners	Colonial administration in East Africa.
Father and Son	Old and young generations in East Africa.
Gold Coast Builders Pottery in the Gold Coast	Two factual films showing native life and work.
Cyprus is an Island	The life of the rural people and many glimpses of the scenic beauty of the island.
Fight for Life	Agricultural problems in West Africa.

All these films have been shown in the Imperial Institute cinema.

Empire Lectures to Schools.—The growth of the Empire Lectures Scheme noted in the last report (this BULLETIN, 1945, **43**, 346) has continued. The total number of lectures given from January to March, 1946, was 912, compared with 715 for the corresponding period last year. It may be remarked that more lectures are given now in three months than during the whole of the first complete season (1941-1942). This is due, not to there being a greater demand for single lectures, but to the fact that many head teachers, finding that the talks have greatly stimulated the children's interest in their geography studies, have invited the Institute to arrange a series of correlated talks at intervals throughout a term, or, in some cases, the whole school year.

The fourth Empire Lecturers' Conference was held at the Institute in January. The discussion was based on a memorandum, prepared by Miss K. M. Reynolds, M.A., J.P., Headmistress of the Park School, Preston, which dealt with "Empire Lectures in Girls' Secondary Schools." Miss Reynolds, two of her staff (the Senior

History Mistress and the Senior Geography Mistress), and two girls from the Upper VI form attended and led the discussion. Several interesting conclusions were reached, amongst which the following may be mentioned:

(*a*) Girls are interested in the social and economic conditions in the various Empire countries, not particularly from an academic point of view, but rather because of the effect of such conditions on the daily life of the people. For this reason the Institute's lecturers, with their personal knowledge, give an invaluable service;

(*b*) In many schools the Empire and its affairs are not viewed in their proper relationship to life in the United Kingdom; and the Institute Lecturers, eschewing the set lecture and making a more informal and human approach are doing much to break down this attitude;

(*c*) There is a great dearth of lively, colourfully-illustrated, up-to-date booklets on Empire countries. These, written from a more personal angle than the text book, are desperately needed to follow up the interest and the fresh outlook on the Empire engendered in schools by the Lectures Scheme.

Among the lecturers who have joined the panel recently are Mr. George Berrie (Australia); Miss M. M. Bruce (Africa); Captain Thomas Domaille (Canada); Mr. James Brook (Australia and the Solomon Islands); Mr. Harry Brooks (West Africa); Mr. F. C. L. Sabine (West Africa, Seychelles and Mauritius); Mr. Norman Manley (New Zealand, India and Pitcairn Island); S/Ldr. A. E. Haarer, F.L.S. (Tanganyika); Mrs. Irvine Douglas (Australia); Dr. Alice Pennell (India); Mr. Harry Cockerell (West Indies); Miss E. M. Hinds (Canada, Australia and New Zealand); and Mr. W. H. Potts (India, Australia and New Guinea).

During the past term the Head Teachers' Association in Coventry kindly offered to make detailed arrangements for lecture tours in their area. The Institute has gladly accepted their invitation, and, during the coming terms, several lecturers will spend a fortnight in Coventry visiting about 30 schools on each occasion. A similar arrangement may come about in Heston and Isleworth (Middlesex), where the Empire Lectures Secretary recently addressed the Head Teachers' Association, explaining the chief features of the scheme. On that occasion also, by way of practical illustration, one of the Institute's Lecturers, Mr. Peter Blackman (West Indies), gave a demonstration lecture to an audience of children; the children's response was excellent and the members of the Association were obviously impressed. This development promises much for the future, and will be encouraged.

Empire Schools Correspondence Scheme.—During the period of

six months under review, 252 introductions have been effected between children in this country and the Empire overseas. In response to our invitation to the Directors of Education in Australia and New Zealand, the Institute is now receiving lists from these two countries, and school children throughout the United Kingdom are being invited to open correspondence with them.

Colonial Visitors.—Many officers and men of the Colonial Contingents visiting London to take part in the Victory Celebrations came to the Institute and were shown the Colonial Courts in the Exhibition Galleries and the Empire film displays in the Cinema. The following is a list of officers on leave from the Colonial Empire who have visited the Institute during the six months ending May 1946:

December

W. C. Clarke, Agricultural Officer, Montserrat.
K. D. Luke, Education Officer, Malaya.
Mrs. P. Luke, Woman Education Officer, Malaya.
A. M. Robinson, Mining Adviser to the Government of Tanganyika.
R. W. Stuckey, Agricultural Officer, Uganda.
W. L. Watt, M.B.E., Senior Agricultural Officer, Kenya.

January

R. F. G. Adams, Senior Education Officer, Nigeria.
H. J. Andrews, Master, Achimota College, Gold Coast.
A. W. Carline, Inspector of Hides, Nigeria.
H. H. Croucher, Deputy Director of Agriculture, Jamaica.
A. G. Hill, Director, East African Agricultural Research Station, Amani, Tanganyika.
F. C. Hummel, Assistant Conservator of Forests, Uganda.
Dr. F. T. Ingham, Mining Geologist, Federated Malay States.
D. R. John, Education Officer, Tanganyika.
Miss W. J. Key, Education Officer, Kenya.
Miss M. Lomas, Education Officer, Malaya.
R. A. M. Mackay, Mining Geologist, Nigeria.
E. S. Willbourn, Director of Geological Survey, Malaya.

February

J. W. Dolphin, Director of Commerce and Industries, Nigeria.
J. J. Lawrie, Assistant Conservator of Forests, Gold Coast.
J. C. Stewart, Superintendent of Education, Tanganyika.

March

A. Bean, Chief Inspector of Mines, Malaya.
M. J. Cooke, Education Officer, Tanganyika.
K. B. Hill, Education Officer, Tanganyika.
R. K. McLeod, Inspector of Mines, Northern Rhodesia.
V. A. Ottaway, Education Officer, Kenya.
E. H. Probyn, Senior Assistant Conservator of Forests, Sierra Leone.
E. W. Wright, Chief Inspector of Mines, Sierra Leone.

APRIL

S. BRACEWELL, Director of the Geological Survey, British Guiana.
DR. R. B. McCONNELL, Geological Survey, Tanganyika.
PROFESSOR J. A. MANCHÉ, Senior Medical Officer, Malta.
L. A. MARKHAM, Assistant Conservator of Forests, Tanganyika.
H. S. SHILL, Chief Horticultural Officer, Department of Agriculture and Fisheries, Palestine.
REV. JOHN TIMMINS, Chaplain to the Bishop of Colombo, Ceylon.
G. H. WILSON, Education Officer, Northern Rhodesia.

MAY

P. C. DAVEY, Political Service, Aden.
C. M. A. GAYER, Assistant Chief Secretary, Uganda.
A. W. HART, Veterinary Officer, Nigeria.
A. HUDDLESTON, Geological Survey, Gold Coast.
DR. R. B. McCONNELL, Geological Survey, Tanganyika.
R. S. MACKILLIGIN, O.B.E., M.C., late Chief Inspector of Mines, Trinidad.
R. H. PULLEN-BURRY, Agricultural Officer, (Sisal Research), Kenya.
G. G. K. SETTEN, Assistant Conservator of Forests, Fiji.
D. THORNTON, Agricultural Officer, Tanganyika.

All Dominion, Indian, Burmese and Colonial Officers, as well as private residents from the Overseas Empire, who may be visiting London, are cordially invited to come to the Institute to see the Exhibition Galleries and to discuss with the Director and his staff, scientific and technical problems in which they may be interested.

BULLETIN
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PLANT AND ANIMAL PRODUCTS

ARTICLE

A REVIEW OF THE PRESENT WORLD POSITION OF THE SUPPLY AND DEMAND FOR OILS AND OILSEEDS WITH SPECIAL REFERENCE TO THE BRITISH EMPIRE

By FRANK E. FEHR, C.B.E.[1]

DURING the war period the imported supplies of Oils and Fats, including Butter, Lard and Margarine, must be considered as satisfactory.

If we take the pre-war years we find that the imported supplies of Oilseeds (expressed in Oil content), Oils and Fats—including Butter, Lard and Margarine—(after deducting exports which were in 1937 138,559 tons and in 1938 127,328 tons) were:

In 1937—1,332,085 tons
1938—1,462,454 „

During the war the imported supplies of Oilseeds, expressed in Oil content, Oils and Fats—including Butter, Lard and Margarine—(after deducting exports which, except for the year 1940 when they were 46,642 tons, were quite negligible) were:

In 1940—1,397,280 tons
1941—1,313,023
1942—1,269,186
1943—1,338,937
1944—1,314,626
1945— 927,891

From these figures you will see that the percentage reduction in imports during the war was comparatively small, showing an approximate reduction of 8 to 10 per cent., but that from an average during the war of about 1,300,000 tons and a pre-war average of

[1] Given at a meeting of the Imperial Institute Consultative Committee on Oils and Oilseeds on 17th May, 1946, at the Imperial Institute.

about 1,400,000 tons we dropped in 1945 to about 927,000 tons. That explains the present shortage of oils and fats in this country.

Throughout the war period there was a considerable diminution in the import of Butter; whereas, say, in 1938 we had an import of Butter of 475,895 tons, the war imports of Butter were:

In 1940—264,350 tons
1941—218,128 ,,
1942—134,314 ,,
1943—151,609 ,,
1944—153,201 ,,
1945—190,134 ,,

These figures show that the war imports varied from 134,000 tons to 264,000 tons, that is, less than half the pre-war import. This diminution was mainly due to lack of imports from the continent.

On the other hand, Lard—of which in 1938 we had an import of 72,046 tons—showed a considerable increase in imports, the year 1940 being an exception when the imports were only 34,731 tons.

In 1941 they rose to 96,569 tons
1942 ,, ,, ,, 218,495 ,,
1943 ,, ,, ,, 218,435 ,,
1944 ,, ,, ,, 189,209 ,,
1945 ,, ,, ,, 90,665 ,,

The big imports of Lard during the war were the effect of Lease-Lend. When in 1945 they dropped off because Lease-Lend came to an end, we had to look elsewhere for additional supplies of Fats.

It is rather striking that when we come to 1945 the total supplies of Oilseeds expressed in Oil content, Oils and Fats (including Butter, Lard and Margarine), show a very considerable reduction, viz. as above indicated, 927,891 tons. Butter in that year kept up to the war level; on the other hand Lard showed a considerable decrease in net imports, and Oils and Fats dropped right down to 674,774 tons (without Butter, Lard and Margarine). This was, no doubt, largely due to the fact that it became necessary to divert a considerable quantity of Oils and Fats and Lard to supply those countries which had been deprived of supplies during the war.

We have to consider what are the prospects of future supplies. No doubt in due course we shall get better supplies of Whale Oil. For the 1945-46 season the quantity expected is 130,000 tons. The next catch, viz. 1946-47, I should think might easily amount to 250,000 tons. We shall gradually get back to the 400-500 thousand tons we had pre-war.

No doubt we shall now get increased supplies of Copra and Coconut Oil. The annual import of Copra pre-war averaged 105,000 to 110,000 tons. During the war the import fell off considerably.

In 1944 it dropped to 32,398 tons.
In 1945 it was rather better at 55,392 tons.

It is stated that the Philippines are shipping at present 25,000 tons a month, and during the last six months of this year it is expected they will ship 200,000 tons. There will not be much oil from the Philippines for some long time because their factories were badly damaged. No doubt the Dutch East Indies will also start shipping and there will be larger supplies from the South Sea Islands. Undoubtedly a portion of this Copra will come to the United Kingdom. The tendency is for most of the Copra to go to the U.S.A., but there will probably be a surplus which will come here.

Whereas as against this it is to be noted that our imports of Palm Kernels pre-war averaged, say, 150,000 tons a year. During the war we received a very much larger quantity.

In 1942, for instance, we received	414,415	tons
1943 „ „ „ „	499,172	„
1944 „ „ „ „	493,635	„

A great effort throughout the war was made to get supplies of oils and fats and oilseeds from the West Coast of Africa as the short journey presented a considerable economy in shipping.

When we come to 1945 a good portion of the Palm Kernels were sent to other destinations and the supplies to the United Kingdom dropped down to 293,083 tons. We must expect a further diminution in the supplies of Palm Kernels to this country as the tendency will be for Kernels to be shipped to a considerable extent as pre-war to other destinations. Pre-war Germany was the main recipient. Now they are going to Belgium, Holland and Scandinavia and that cuts down supplies to this country.

In Decorticated Groundnuts pre-war we had an average supply of, say, 280,000 tons. Again here during the war the supplies received in this country increased considerably, the peak year being 1941 when we had 606,909 tons. In 1945 the quantity had again dropped to 406,479 tons. Here, again, we must expect some diminution in supplies as Groundnuts will be diverted to other centres.

Soya Beans were never a very important article for this country. Pre-war our supplies were about 95,000 tons. During the war supplies dropped to a few thousand tons a year, except for 1943 when we received a fair quantity from the U.S.A., namely 28,189 tons. Manchuria produced 4½ million tons pre-war. All that supply was cut off during the war but it is presumed that in due course Manchuria will again become an exporter of Soya Beans.

As far as Linseed is concerned, pre-war our average imports were about 290,000 tons. During the war supplies increased considerably and varied from 232,100 tons to the peak year of 1943 when they were 506,998 tons. In 1945 the imports dropped right down to 142,307 tons. It is to be hoped that with normal crops in India again we shall get better supplies of Linseed from there, and that also there will be a tendency for the Argentine to have larger quantities available for export.

Pre-war our imports of Cottonseed were about 600,000 tons. During the war imports dropped very considerably, and in 1943 we had come down to 14,411 tons, and in 1944 to 10,027 tons. In 1945 we had again some increase, and the imports amounted to 41,848 tons.

It is to be presumed that Cottonseed imports will again be greatly increased. Egypt will no doubt get back to a more normal production although, undoubtedly, she will require a larger quantity for her own consumption than formerly. During the war little Cottonseed was imported as it only has an 18 per cent. oil content.

In South America, where there has been a very largely increased production of Groundnuts and Sunflower seed, there has also been a very large increase in crushing capacity. The Argentine is now able to crush 1,350,000 tons of Sunflower seed, which is a very marked advance on what she was able to crush pre-war. Her crushing capacity is as follows:

1,350,000	tons of	Sunflower seed
217,800	,, ,,	Cottonseed
954,000	,, ,,	Linseed

which is a very great increase.

No doubt we shall see an extension of crushing at points of production such as South America, India, Malaya, Australia and China, although crushing at the consuming centre has the advantage of giving the crusher a much wider market from which to draw his raw material.

We must expect an increased consumption of Oils and Fats the world over as the demand for soap will increase, also the demand for margarine, as vitaminised margarine tends more and more to replace butter, but it should be possible to extend the production of Oilseeds to meet this demand. We have seen the enormous advance made in the production of Palm Oil in Sumatra—a comparatively new production; in 1930 the quantity produced totalled 56,000 tons; by 1938 it had reached over 200,000 tons. The U.S.A. in 1936 produced 793,286 tons of Soya Beans; in 1944 the production totalled 5,165,973 tons. Undoubtedly in South America, Africa, Australia and also in Asia there is room for an enormous increase in supplies.

During the war fresh sources of supply were created; these will tend to continue to produce, and we shall have pre-war production steadily restored.

We can expect the Whale Oil production in due course again to reach 4-500,000 tons, and we shall again get normal butter imports. Butter home production, which pre-war totalled about 40-50,000 tons, was considerably reduced during the war, but will now slowly tend to increase.

As traders, our one fear is that restrictions and pool purchasing will tend to restrain that free movement of commodities which is essential to obtain maximum supplies.

Too much emphasis cannot be placed on the necessity of inducing a free flow of merchandise (manufactured consumer goods) to producing countries in order to encourage the maximum collection and production of supplies of Oilseeds and Oils. If the producer can get actual goods in exchange for his produce, the effect on supplies is most marked.

In Borneo and New Guinea the whole labour basis has been upset. The Australian Government has introduced certain restrictions as regards labour. The Premier of Australia has had the whole matter placed before him recently, and it is hoped that something may be done.

It will need a very great effort in all these Dominions to set the wheels of production in motion again. In twelve months we should have enough oils and fats in this country to get through ; at the moment the position is most acute. I shall be very pleased to give any further details if they are required.

In this connection is relevant the following statement made by Mr. George Hall, the Secretary of State for the Colonies, in his speech on Colonial Affairs in the House of Commons on July 9, 1946 :

> " Many new industries have also been started in the Colonies during the war, and industries which existed on a very small scale have been substantially expanded. Some of these industries will be the foundations on which we shall build for the permanent enrichment of the Colonies. Some are suffering from the world food shortage, particularly the Far East Colonies and Ceylon. His Majesty's Government are doing their utmost to minimise suffering due to these shortages. In spite of them, there is everywhere in the Colonies a determination to send more food to Britain, and with the co-operation of my colleague, the Minister of Food, I am doing everything possible to help them to fulfil this task. A bumper crop of groundnuts has just been harvested in Nigeria. Supplies of this valuable source of fat are, however, so short, and are likely to be for some years to come, that the Government have decided to make a special investigation of a project for large-scale new production of groundnuts in East Africa. A team of expert investigators is now in Tanganyika carrying out that investigation. We have also just decided to send a mission to West Africa to see what assistance can be given to increase production, and to speed up the transport of groundnuts and palm kernels. My Department is continuing discussions with the Ministry of Food to ascertain whether a field exists elsewhere in the Colonies for similar encouragement of fats production."

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the Reports made to the Dominion, Indian and Colonial Governments

CINNAMON BARK OIL FROM SEYCHELLES

By D. J. Cosgrove, B.Sc., A.R.I.C., and H. T. Islip, B.Sc., F.R.I.C.

Cinnamon bark has been produced in Seychelles for a number of years and in 1916 large quantities of the essential oil obtained on distilling the bark in steam were prepared. The oil was however of low quality. By 1933 this oil had ceased being produced. More recently the production of cinnamon bark oil has been restarted, but on a very small scale, only 56½ kilos. having been exported in 1940.

There is no doubt at all that a useful oil can be obtained from Seychelles cinnamon bark but unfortunately the straight oil does not fulfil the requirements of the British Pharmacopœia, in respect of solubility in 70 per cent. alcohol. The Imperial Institute has from the commencement played an active part in the development of essential oil production in the Seychelles, and particularly with reference to cinnamon oil, see this Bulletin (1934, **32**, 551; 1937, **35**, 298). Recently investigations have been undertaken by the Department of Agriculture, Seychelles, and by the Imperial Institute to determine whether it is possible by fractional distillation to obtain an oil which would meet the official specification.

The results of the most recent work on this problem are published in the following two reports. These deal with samples of oil prepared by fractional distillation of the bark. Those forming the subject of Report A were prepared in Seychelles, while Report B relates to oils prepared at the Imperial Institute. These oils were submitted to a chemical examination at the Imperial Institute and trials were made by mixing fractions in suitable proportions to prepare an oil of B.P. standard.

Report A.—Oils Prepared in Seychelles

Four samples of oil were received from the Director of Agriculture, Seychelles. They had been obtained by the dry steam distillation of unscraped cinnamon bark, Sample 1 being the oil removed during the first 15 minutes distillation, Sample 2 the remainder of the oil obtained by continuing the distillation for a further 3 hours (i.e. until exhaustion of the bark), and Samples 3 and 4 the oil obtained respectively from the first and second re-distillations of the aqueous distillates.

Results of Examination

The samples as received consisted of:

TABLE I

CONSTANTS OF CINNAMON OILS

	Present samples from Seychelles.				Requirements of B.P. 1932.	Commercial Samples of B.P. Cinnamon Oil.		
	Sample 1. From first 15 mins. distillation. (16·4 per cent. of total volume of the 4 samples).	*Sample* 2. From further 3 hrs. distillation. (58·4 per cent. of total volume of the 4 samples).	*Sample* 3. From first redistillation of the aqueous distillate. (11·1 per cent. of total volume of the 4 samples).	*Sample* 4. From second redistillation of the aqueous distillate. (14·1 per cent. of total volume of the 4 samples).		*Sample No.* 1.	*Sample No.* 2	*Sample No.* 3.
Specific Gravity 15·5°/15·5° C.	0·9615	0·9885	1·0274	1·0396	1·000 to 1·030	1·0208	1·0199	1·0370
Optical Rotation, a_D	−4·14° at 21° C.	−2·98° at 22° C.	−1·57° at 23° C.	−0·96° at 22° C.	0° to −2° 20° C.	−1·20° at at 20° C.	−0·96° at 22° C.	Optically inactive at 20° C.
Refractive Index, $n_D 20°$ C.	1·5450	1·5618	1·5879	1·5979	1·565 to 1·582	1·5752	1·5762	1·5780
Cinnamic aldehyde (hydroxylamine method) w/w *per cent* *	45·6	55·5	70·7	76·9	50 to 65	60·1	58·7	56·7
Solubility in 70 per cent alcohol at 15·5° C.	Insoluble in 10 vols.	Insoluble in 10 vols.	Soluble in 2·7 vols.	Soluble in 2·1 vols. with very slight opalesence.	Soluble in 3 vols. with not more than slight opalescence	Soluble in 2·5 vols.	Soluble in 2·5 vols. with very slight opalescence.	Soluble in 1·6 vols.
B.P. Test for absence of cinnamon leaf and cassia oils†	Passes Test.	Passes Test.	Passes Test.	Passes Test.	See Test below†	Passes Test.	Passes Test.	Passes Test.

* *B.P.* 1932, *p.* 582.

† *B.P. Test: Slight green, but not a blue or a deep brown, colour produced on adding* 1 *drop of ferric chloride solution to a solution of* 1 *drop of the oil in* 5 *ml. of* 90 *per cent. alcohol.*

Sample 1.—245 ml. of a clear oil having a very slight crystalline deposit.

Sample 2.—870 ml. of a clear oil having a slight crystalline deposit.

Sample 3.—165 ml. of a slightly opalescent oil.

Sample 4.—210 ml. of a slightly opalescent oil.

Samples 1 and 2 were pale yellowish-brown in colour, Sample 3 yellowish to reddish-brown and Sample 4 somewhat paler than Sample 3, though darker than Samples 1 and 2. The odour of Samples 2 and 3 was quite good, and that of Sample 1 rather weak, whilst the odour of Sample 4 was rather too predominant of cinnamic aldehyde to be considered good.

On examination the oils after filtration through paper were found to have the analytical constants given in Table I, where they are shown in comparison with the requirements of the British Pharmacopœia, 1932, and also with the constants of three commercial samples of cinnamon oil, B.P., purchased recently in London.

It will be observed that, apart from the test for the presence of cinnamon leaf and cassia oils, none of the present samples conformed to the British Pharmacopœia requirements in all other respects. As might be expected, Sample 1 failed in all particulars, whilst Sample 2 only conformed as to cinnamic aldehyde content. Samples 3 and 4 both failed on refractive index and cinnamic aldehyde content, Sample 4 in addition having too high a specific gravity. Incidentally, one of the commercial samples also had a specific gravity in excess of the maximum permitted.

Attempts were then made to produce oils conforming to the British Pharmacopœia requirements by mixing the present samples, in pairs, in such proportions that the cinnamic aldehyde content of the mixtures would be approximately 65 per cent., the maximum permitted by the British Pharmacopœia.

These proportions were (*a*) 3 volumes Sample 1 with 10 volumes Sample 3, (*b*) 3 volumes Sample 2 with 5 volumes Sample 3, (*c*) 3 volumes Sample 1 with 5 volumes Sample 4, and (*d*) 5 volumes Sample 2 with 4 volumes Sample 4.

Apart from the optical rotation, which was slightly in excess of —2°, the calculated constants of the four mixtures fell within the British Pharmacopœia limits, but when actual mixtures were tested for solubility in 70 per cent. alcohol all failed to dissolve in 3 volumes, at least 9 volumes being required to effect solution.

It was then decided to ascertain what amount of Sample 2, the largest fraction, could be added to Samples 3 and 4 so that the mixtures were soluble in 3 volumes of 70 per cent. alcohol. On trial it was found that mixtures of 10 volumes Sample 3 with 1·2 volumes Sample 2 (mixed oil (*e*)) and 2 volumes Sample 4 with 1 volume Sample 2 (mixed oil (*f*)) had the correct solubility, being soluble in 3 volumes with slight opalescence.

By calculation these two oils would have the following constants :

TABLE II

	Mixed oil (e)	Mixed oil (f)
Specific Gravity, 15·5/15·5° C.	1·023	1·021
Optical Rotation, α_D22° C.	−1·7°	−1·6°
Refractive Index, n_D20° C.	1·585	1·586
Cinnamic aldehyde, *per cent.*	69·1	70·0

The refractive index of these oils was slightly in excess of the British Pharmacopœia limit, and the cinnamic aldehyde content was 4 per cent. and 5 per cent. respectively above the maximum permitted, but in other respects the oils conformed to the British Pharmacopœia standards, and both were soluble in 3 volumes of 70 per cent. alcohol.

By making up these mixtures the whole of Sample 3 (165 ml.) plus 19·8 ml. of Sample 2 would furnish 184·8 ml. of mixed oil (*e*), and Sample 4 (210 ml.) plus 105 ml. of Sample 2 would produce 315 ml. of mixed oil (*f*). This would make a total of 499·8 ml. of oil, soluble in 70 per cent. alcohol but containing a little under 70 per cent. cinnamic aldehyde, that is about a third of the total oil distilled.

This proportion of soluble oil, which moreover did not actually conform to the British Pharmacopœia, is unlikely to be an economic yield, and experiments was therefore carried out with a view to increasing the proportion of the soluble oil obtained from the samples. This insolubility would be due mainly to the presence of an undue amount of terpenes in the oil. It was therefore considered that by submitting Sample 2 to steam distillation and removing the oil first distilling over (which would be rich in terpenes) the residual oil might become soluble. Two experiments were carried out on these lines, in which approximately 10 per cent. and 20 per cent. respectively of Sample 2 was removed by steam distillation. The constants of the residual oils, referred to as Fraction 2A and Fraction 2B respectively, and of the more volatile portions removed from Sample 2 to produce these oils are given in Table III below.

TABLE III

	Fraction 2A. (Sample 2 after removal of 11·8 per cent. by steam distillation.)	Fraction 2B. (Sample 2 after removal of 21·7 per cent. by steam distillation.)	Light oil A. (11·8 per cent. of Sample 2 removed by steam distillation.)	Light oil B. (21·7 per cent. of Sample 2 removed by steam distillation.)
Specific Gravity, 15·5/15·5° C.	0·9999	1·0117	Not determined	
Optical Rotation, α_D at 20° C.	−2·22°	−1·78°	−9·18°	−8·68°
Refractive Index, n_D 20° C.	1·5712	1·5804	1·4899	1·4932
Cinnamic aldehyde, *per cent.*	61·0	66·5	6·8	9·0
Solubility in 70 per cent. alcohol	Insoluble in 10 volumes		Insoluble in 10 volumes	

From the above table it will be seen that Fraction 2A failed to conform to the British Pharmacopœia requirements as regards optical rotation, and Fraction 2B as regards cinnamic aldehyde content; moreover both were insoluble in 70 per cent. alcohol.

Mixtures were then made of the two oils Fraction 2A and Fraction 2B with Samples 3 and 4 so that the resulting oils were soluble in 3 volumes of 70 per cent. alcohol. The proportions found for these mixtures (mixed oils (*g*), (*h*), (*i*) and (*j*)), together with calculated figures for the constants, are shown in Table IV below.

TABLE IV

Oil.	Mixed oil (*g*).	Mixed oil (*h*).	Mixed oil (*i*).	Mixed oil (*j*).
Consisting of:	6 vols. Sample 3 + 1 vol. Fraction 2A.	5 vols. Sample 4 + 3 vols. Fraction 2A.	3 vols. Sample 3 + 1 vol. Fraction 2B	5 vols. Sample 4 + 4 vols. Fraction 2B.
Specific Gravity, 15·5/15·5° C.	1·023	1·025	1·023	1·027
Optical Rotation, α_D at 20° C.	−1·7°	−1·4°	−1·7°	−1·3°
Refractive Index, n_D 20° C.	1·586	1·588	1·586	1·590
Cinnamic aldehyde, *per cent.*	69·3	71·1	69·7	72·3

It will be seen that although the four mixed oils are satisfactory in respect of solubility, i.e. soluble in 3 volumes of 70 per cent. alcohol, they fail to conform to the British Pharmacopœia standards in respect of refractive index, by a slight margin, and cinnamic aldehyde content by an appreciable amount.

These calculated constants are very similar to those obtained by mixing Samples 3 and 4 with Sample 2 without redistillation. The quantities of oil capable of being produced by mixing in this way would be as follows:

Mixed oil (*g*)	165 ml.	Sample 3 + 27·5 ml.	Fraction 2A = 192·5 ml.
Mixed oil (*h*)	210 ml.	Sample 4 + 126 ml.	Fraction 2A = 336 ml.
Mixed oil (*i*)	165 ml.	Sample 3 + 55 ml.	Fraction 2B = 220 ml.
Mixed oil (*j*)	210 ml.	Sample 4 + 168 ml.	Fraction 2B = 378 ml.

Mixed oils (*g*) and (*h*) would together produce 528·5 ml. oil or 35·5 per cent. of the total distillate, whilst mixed oils (*i*) and (*j*) would furnish 598 ml. of oil, equivalent to 40·1 per cent. of the total oil distilled.

Thus the largest yield of a soluble oil obtained from the present samples amounted to only 40 per cent. of the total oil, and this oil, though soluble in 3 volumes of 70 per cent. alcohol, failed to conform to the British Pharmacopœia with respect to refractive index and cinnamic aldehyde content.

In view of the insolubility of the residual oil after removing the bulk of the terpenes, as in Fraction 2B, it was decided to determine

the eugenol content of the Seychelles samples in comparison with the commercial oils. The results were as follows:

TABLE V

	Eugenol, *Per cent, v/v.*
Present oils from the Seychelles.	
No. 1	2·2
No. 2	3·3
No. 3	5·0
No. 4	6·0
Commercial oils.	
No. 1	10·5
No. 2	8·5
No. 3	8·5

Summary

None of the four present samples of cinnamon bark oil from the Seychelles conformed to the requirements of the British Pharmacopœia, 1932, and it was not found possible by mixing the samples, with or without additional fractional steam distillation, to obtain an oil which did conform. In order to be soluble in 3 volumes of 70 per cent. alcohol at least 69 per cent. of cinnamic aldehyde was present, and this oil just failed to conform to the British Pharmacopœia with respect to refractive index.

Remarks

According to Schimmel & Co. (*Semi-Annual Reports*, November, 1908, p. 41, and April, 1913, p. 42), Seychelles cinnamon bark oil has the same constituents as the Ceylon oil, with the addition of camphor not found in the Ceylon product. (Tests carried out on the present samples of oil after removal of aldehydes and phenols failed to disclose the presence of camphor, which, if present at all, would be in insignificant amounts). The difference in analytical constants of the two oils would appear therefore to be due to differences in the relative amounts of the numerous constituents in the oils. From the experiments carried out at the Imperial Institute described in this report it does not appear that the insolubility of the Seychelles oil is due entirely to the presence of excessive amounts of terpenes, since after the removal of a fair proportion of these the resulting oils (Fractions 2A and 2B) were still insoluble in 70 per cent. alcohol, and soluble oils contained at least 69 per cent. cinnamic aldehyde. It would seem, therefore, that some other soluble constituent, or constituents, is present in smaller amounts than is the case with Ceylon cinnamon oil as marketed in this country.

In this connection it may be noted that the three commercial cinnamon bark oils examined contained more eugenol (8·5 to 10·5 per cent.) than the present samples of oil from the Seychelles (2·2 to 6·0 per cent.).

Taking the mixed oils into consideration the presence of a little more eugenol (up to say 10 per cent.) would reduce the cinnamic aldehyde content, probably to the 65 per cent. maximum of the British Pharmacopœia and at the same time reduce the refractive index so that that too would conform to the British Pharmacopœia requirements.

It is doubtful if the cinnamon oil marketed in the United Kingdom, whether distilled here or in Ceylon, is obtained by a simple distillation of the bark. In this connection it may be mentioned that commercial sample No. 2 was labelled, "This oil is not offered as a direct distillation of cinnamon bark but conforms to the analytical tests of the British Pharmacopœia, 1932." In Ceylon it is common practice to add a proportion of cinnamon leaf oil to the bark oil, or alternatively to steam distil a mixture of bark and leaves. This practice may account for the high eugenol content of some of the oils exported from Ceylon.

On the other hand, Guenther (*Spice Mill*, March, 1941, p. 38) distilling different types of bark material in the Negombo district of Ceylon, found high amounts of eugenol in all types, viz. 16 per cent. in oil from quillings, 18 per cent. from featherings, and 38 per cent. from chips. It may be, therefore, that the amount of eugenol naturally present in Ceylon bark, obtained mostly from cultivated bushes, is significantly greater than that present in the bark of the trees growing wild in Seychelles.

Report B.—Oils Prepared at the Imperial Institute

Two samples of bark were received from the Director of Agriculture, Seychelles. It was desired to ascertain whether an oil conforming to the requirements of the British Pharmacopœia could be obtained from this bark by steam distillation.

Description

The samples were as follows:

I. *Scraped Bark.*—The sample consisted on the whole of irregular pieces and fragments of bark freed from the rough outer bark. A few rough, incomplete quills were also present, up to 9 cm. in length and 1 cm. in diameter. The pieces were up to 10 cm. long, 4 cm. broad and 0·5 cm. thick, but the fragments, which accounted for the major part of the sample, were much smaller than this. The material was of fairly uniform, dull yellowish-brown colour, and had the characteristic odour and taste of cinnamon bark. Small amounts of leaves and pieces of wood were present in the sample.

II. *Unscraped Bark.*—The sample consisted almost entirely of small irregular pieces and fragments of bark, though a few rough quills were also present. The pieces were up to 5 cm. long, 2·5 cm. broad and 0·5 cm. thick. The internal surface was somewhat darker than the scraped bark, whilst the external surface, being

the outer bark, was a much darker brown, and very rough. The odour of the bark was less pronounced and the taste less pleasant than in the case of Sample I, the scraped bark.

Results of Examination

Although the examination of samples of oil obtained by fractional steam distillation, in the Seychelles, of unscraped cinnamon bark, and of oils obtained by additional steam distillation of these fractions at the Imperial Institute had indicated that the production of oil fulfilling all the requirements of the British Pharmacopœia was impracticable (see Report A), it was thought that useful information might be obtained by subjecting the present samples of scraped and unscraped barks to fractional steam distillation at the Imperial Institute.

In order to follow the changes in composition taking place during the distillation it was thought desirable to collect four fractions, approximately equal in amount, during the initial distillation of the bark itself, the oil obtained from the first, second and subsequent distillations of the aqueous distillates being also collected as separate fractions.

The largest quantity of bark, previously reduced in a disintegrator so as to pass a ⅛th-inch mesh sieve, which could be handled conveniently in the still in use at the Imperial Institute was 30 lb.; it was therefore necessary to carry out a number of replicate distillations and bulk the various fractions in order to obtain sufficient of each fraction for subsequent examination.

I. Distillation of Scraped Bark

(i) Main Distillations

Preliminary distillation trials were first carried out to determine at what points it was necessary to change the receivers in order to obtain four fractions of oil of approximately equal volume. Subsequently, the following fractions were collected from each 30 lb. charge of bark:

Fraction S1.—Obtained whilst 700 ml. of aqueous distillate collected.

Fraction S2.—Obtained whilst a further 1,200 ml. of aqueous distillate collected.

Fraction S3.—Obtained whilst a further 2,170 ml. of aqueous distillate collected.

Fraction S4.—Obtained as a result of continuing the steam distillation to complete exhaustion of the bark.

Six distillations were carried out in the above manner, and the corresponding fractions amalgamated, the aqueous portions of the distillates being allowed to stand for some time and any oil separating from them being added to the appropriate fraction.

The combined aqueous distillate, freed as far as possible from separated oil, was redistilled and the oil obtained (Fraction SD1)

collected. The aqueous distillate from this fraction was again distilled to provide Fraction SD2, and this operation repeated twice more to furnish Fractions SD3 and SD4, by which time the bulk of the aqueous distillate had been reduced to about 5 litres.

Particulars of the various fractions are given in Table I below:

TABLE I

Fraction.	Yield of oil, per cent. by weight. Expressed on the bark.	Expressed on total oil.	Character of Oil.
S1	0·055	12·1	Pale yellow. Odour rather weak.
S2	0·050	11·1	Pale yellow, very slightly darker than S1. Odour fairly good.
S3	0·065	14·3	Similar to S2 in colour. Odour good.
S4	0·056	12·3	Yellowish-brown. Odour good.
SD1	0·106	23·3	Brownish-yellow, yellower than S4. Odour strong, and predominantly that of cinnamic aldehyde.
SD2	0·070	15·4	Similar to S1 in colour and SD1 in odour except for a slight subsidiary odour of benzaldehyde.
SD3	0·035	7·7	Similar to S1 in colour. Pronounced odour of benzaldehyde masking that of cinnamic aldehyde.
SD4	0·017	3·8	Similar to SD3.
Total	0·454	100·0	

The eight fractions, after filtration through paper, were found to have the analytical constants given in Table II, which are there shown in comparison with the requirements of the British Pharmacopœia, 1932. The British Pharmacopœia test for absence of cinnamon leaf and cassia oils was not carried out as this was, of course, unnecessary.

It will be seen that none of the fractions conformed to the requirements of the British Pharmacopœia, and the figures indicate that the possibility of compounding an oil of British Pharmacopœia standard by mixing the fractions was remote.

(ii) Adjustment of Solubility by mixing fractions

Some of the insoluble and soluble fractions were, however, mixed in such proportions (which were determined by trial) that the resulting mixtures were just soluble in 3 volumes of 70 per cent. alcohol. This aim was achieved when the various fractions were mixed in the proportions given below:

Mixed fraction A—2 vols. S1 mixed with 5 vols. SD1
" " B—5·1 vols. S2 mixed with 6 vols. SD1
" " C—3 vols. S3 mixed with 5 vols. SD1
" " D—1 vol. S4 mixed with 2 vols. SD1
" " E—4 vols. S1 mixed with 5 vols. SD2

TABLE II

ANALYTICAL CONSTANTS OF FRACTIONS OF OIL

Fraction.	S1.	S2.	S3.	S4.	SD1.	SD2.	SD3.	SD4.	Requirements of the British Pharmacopœia 1932.
Specific Gravity at 15·5/15·5° C.	0·9451	0·9782	0·9986	1·0156	1·0369	1·0465	1·0462	1·0479	1·000 to 1·030
Optical Rotation α_D22° C.	−7·31°	−4·93°	−3·45°	−2·31°	−1·14°	−0·44°	−0·28°	−0·16°	0° to −2°
Refractive Index, n_D20° C.	1·5355	1·5590	1·5730	1·5774	1·5970	1·5977	1·5770	1·5669	1·565 to 1·582
Cinnamic aldehyde (hydroxylamine method) w/w, *per cent.*	41·8	57·3	65·4	66·1	82·7	95·3	106·3*	111·9*	50 to 65
Solubility in 70 per cent. alcohol at 15·5° C.	Insoluble in 10 vols.	Insoluble in 10 vols.	Insoluble in 10 vols.	Insoluble in 10 vols.	Soluble in 2·2 vols. with slight opalescence.	Soluble in 1·8 vols.	Soluble in 1·4 vols.	Soluble in 1·3 vols.	Soluble in 3 vols. with not more than slight opalescence.
Phenols (by absorption) v/v, *per cent.*	0·5	0·5	2·0	†	3·3	3·0	‡	‡	—

* *These abnormally high figures were, presumably, due to the presence of benzaldehyde, no doubt produced by the oxidation of cinnamic aldehyde resulting from the numerous redistillation operations preceding these fractions.*

† *The determination could not be carried out satisfactorily with this sample as complete and clean separation of the unabsorbed oil did not take place.*

‡ *Insufficient available to permit of this estimation.*

By calculation, these five oils would have the constants shown in Table III below:

TABLE III

Mixed Fraction.	A.	B.	C.	D.	E.
Specific Gravity, 15·5/15·5° C.	1·011	1·010	1·023	1·030	1·001
Optical Rotation $\alpha_D 22°$ C.	−2·90°	−2·88°	−1·99°	−1·53°	−3·32°
Refractive Index, $n_D 20°$ C.	1·579	1·580	1·588	1·591	1·571
Cinnamic aldehyde, w/w, *per cent.*	71·8	71·4	76·4	77·3	72·9
Phenols, v/v, *per cent.*	2·5	1·3	2·8	*	1·95

* *Not calculable in the absence of a figure for fraction S4.*

It will be seen that all the mixed fractions failed to conform to the British Pharmacopœia requirements with respect to aldehyde content; in addition the optical rotations of mixed fractions A, B and E were too high.

The cinnamic aldehyde content of mixed fractions A, B and E, i.e. oils containing fractions S1 or S2, is in close agreement with the figures 69·1 to 72·3 per cent. found with various mixed oils just soluble in 70 per cent. alcohol obtained with the samples of cinnamon bark oil distilled in the Seychelles from unscraped bark as stated in Report A. The cinnamic aldehyde content of mixed fractions C and D, containing fractions S3 and S4 was, however, considerably higher.

By mixing together the whole of fractions S1, S2 and SD1 and 78 per cent. (by weight) of fractions SD2 (the fractions producing soluble mixed oils having the lowest amounts of cinnamic aldehyde, viz. mixed fractions A, B and E) an oil would result amounting to 58·5 per cent. (by weight) of the oil obtained by carrying the steam distillation of the bark to complete exhaustion, that is a yield of 0·266 per cent. expressed on the bark; or 66 per cent. of the oil obtained up to the stage of the second distillation of the aqueous distillates, beyond which point it would not be economical to proceed. Such a mixed oil would, by calculation, have the constants shown in Table IV below:

TABLE IV

Specific Gravity, 15·5/15·5° C.	1·007
Optical Rotation, $\alpha_D 22°$ C.	−3·04°
Refractive Index $n_D 20°$ C.	1·577
Cinnamic aldehyde, w/w, *per cent.*	72·0
Phenols, v/v, *per cent.*	1·8

This oil represents the maximum amount of oil which could be obtained consistent with it being just soluble in 3 volumes of 70 per cent. alcohol and containing a minimum of cinnamic aldehyde; being composed of mixtures of mixed fractions A, B and E it fails to conform to the requirements of the British Pharmacopœia in respect to optical rotation and cinnamic aldehyde content.

(iii) Modified Distillation

In view of the foregoing results and the fact that, apart from

an excessive cinnamic aldehyde content, a high optical rotation was one of the drawbacks of any of the mixtures, it was considered that some improvement might be achieved if a small fraction, about half to three-quarters the size of fraction S1, were first collected, the distillation being then continued to a point just short of completion (to avoid the inclusion of difficultly soluble sesquiterpenes) and the first distillation of the aqueous distillate added to the main fraction so as to provide a fairly large amount of oil which should be soluble in 3 volumes of 70 per cent. alcohol.

Two such steam distillations, each of 30 lb. of the ground bark, were carried out in this way, and each pair of corresponding fractions mixed, providing fractions 2S1 and 2S2 ; a third fraction 2SD was also collected by distilling the combined aqueous distillates a second time.

Particulars of the fractions obtained in this way are given in Table V below :

TABLE V

Fraction.	Yield of oil, per cent, by weight. Expressed on the bark.	Expressed on total oil.	Character of the Oil.
2S1	0·031	9·1	Pale yellow-coloured oil, having a weak odour of cinnamic aldehyde combined with a pronounced terpenic odour.
2S2	0·270	79·4	Yellow oil of good cinnamon odour.
2SD	0·039	11·5	Pale yellow oil having a strong odour of cinnamic aldehyde with a slight subsidiary odour of benzaldehyde.
Total	0·340	100·0	

The yield of oil, 0·34 per cent., is considerably less than the total oil obtained with the first series of distillations up to the corresponding point, that is fractions up to and including fraction SD2, viz. 0·407 per cent. This difference is probably due to the steam distillation not having been carried out to complete exhaustion of the bark, coupled with losses sustained in handling smaller quantities of oil.

The three foregoing fractions, after filtration through paper, had the constants given in Table VI below:

TABLE VI

Fraction.	2S1.	2S2.	2SD.
Specific Gravity 15·5/15·5° C.	0·9137	1·0224	1·0449
Optical Rotation, $a_D 20°$ C.	−9·96°	−2·09°	−0·33°
Refractive Index, $n_D 20°$ C.	1·5140	1·5885	1·6061
Cinnamic aldehyde, w/w, *per cent.*	27·8	75·0	90·0
Solubility in 70 per cent. alcohol at 15·5° C.	Insoluble in 10 vols.	Soluble in 2·9 vols.	Soluble in 1·9 vols.
Phenols (by absorption), v/v, *per cent.*	*	5·0	*

* *Insufficient available to permit of this estimation.*

As anticipated, fraction 2S1 had a considerably lower specific gravity and cinnamic aldehyde content, and a higher optical rotation than fraction S1 (Table II), the effect on the last constant being the chief purpose for collecting this particular fraction, so as to remove highly optically active constituents.

Fraction 2SD corresponds to fraction SD2 (Table II), being the oil obtained from the second distillation of the aqueous distillates. There are, however, significant differences in the constants of the two fractions for which no adequate explanation can be offered, except that the lower figures for cinnamic aldehyde found in fraction 2SD no doubt results from the presence of considerably less benzaldehyde in this fraction, due to the less numerous operations preceding the collection of the fraction as compared with fraction SD2.

With regard to the main fraction 2S2, representing 79·4 per cent. of the total oil obtained, it will be seen that this oil fails to conform to the requirements of the British Pharmacopœia in respect to refractive index and cinnamic aldehyde content; the optical rotation also is just above the permitted maximum of —2°. As shown in Table V, fraction 2S2 amounted to 79·4 per cent. of the total oil, compared with 66 per cent. for the composite oil, the calculated constants of which are shown in Table IV. It must be realised, however, that the two oils are of different character, and that in producing (with 2S2) an oil having a lower optical rotation, as was the aim of the distillation, the cinnamic aldehyde content has increased and the refractive index no longer conforms to the British Pharmacopœia requirements. The content of cinnamic aldehyde and the refractive index would be reduced by the admixture of fraction 2S1, but this would throw the optical rotation further out and, in any case, the amount of fraction 2S1 which could be added consistent with the mixed oil remaining soluble in 3 volumes of 70 per cent. alcohol would be small.

(iv) *Variation of Eugenol Content*

So far no reference has been made in this report to the phenol content of any of the fractions obtained. No limits for this are given in the British Pharmacopœia, the nearest approach being the test designed to disclose the presence of cinnamon leaf oil and cassia oil. As stated on p. 193, commercial Ceylon cinnamon oils may contain relatively high amounts of eugenol and three commercial cinnamon oils examined at the Imperial Institute were found to contain 8·5 to 10·5 per cent. eugenol. By reference to Tables II, III, IV and VI it will be seen that, in all cases where the determination could be made, the phenol content of the various fractions was much below the figures obtained with the commercial samples.

To test the theory that the insolubility of Seychelles cinnamon oil is due, at least in part, to a deficiency of eugenol, it was thought

desirable to add eugenol to fraction 2S2, with the addition of a small amount of fraction 2S1 to reduce further the cinnamic aldehyde content of the mixture, care being taken to ensure that this mixture was soluble in 3 volumes of 70 per cent. alcohol. The eugenol used, which had been isolated from Seychelles cinnamon leaf oil, had the following constants:

Specific Gravity, 15·5/15·5° C.	1·0707
Optical Rotation α_D	0°
Refractive Index, $n_D20°$ C.	1·5403

Fraction 2S1 was added to fraction 2S2 containing 12 per cent. v/v eugenol in such quantity that the resulting mixture was just soluble in 70 per cent. alcohol; the quantities found to be necessary were 1·2 volumes fraction 2S1 and 12 volumes of fraction 2S2 containing 12 per cent. eugenol. The calculated constants of the mixture so obtained are shown in Table VII below:

TABLE VII

Specific Gravity, 15·5/15·5° C.	1·0147
Optical Rotation $\alpha_D20°$ C.	−2·7°
Refractive Index, $n_D20°$ C.	1·5778
Cinnamic aldehyde, w/w, *per cent.*	65
Solubility in 70 per cent. alcohol at 15·5° C.	Soluble in 3·0 vols.
British Pharmacopœia test for cinnamon leaf and cassia oils	Passes test
Phenols, v/v, *per cent.*	10·8

It will be seen that this oil conforms to the requirements of the British Pharmacopœia in all respects except the optical rotation. By raising the eugenol content of the whole of fraction 2S2 to 12 per cent. v/v and mixing this with the correct amount of fraction 2S1, 87·5 per cent. by weight of the total oil distilled would be employed.

Eugenol was also added up to a maximum of 10 per cent. to various mixtures of some of the fractions obtained in the main distillations, but in every case the resulting mixed oil failed to conform to the British Pharmacopœia requirements in one respect—either the optical rotation or the cinnamic aldehyde content was too high, and the quantity of mixed oil so obtained was much less than the 87·5 per cent. mentioned above.

II. Distillation of Unscraped Bark

A series of fractional steam distillations was carried out on the unscraped bark similar to that employed with the scraped bark but, owing to the smaller size of the sample, it was not possible to make more than one preliminary trial distillation to determine when the receivers should be changed. The yield of oil obtained in this distillation was much smaller than was expected; in consequence of this and the fact that no additional trials could be made, the fractions finally collected were not as similar in size as was hoped.

The following fractions were subsequently collected from each

30 lb. charge of bark, previously reduced in a disintegrator as in the case of the scraped bark :

Fraction U1. Obtained whilst 300 ml. of aqueous distillate collected.
Fraction U2. Obtained whilst a further 480 ml. aqueous distillate collected.
Fraction U3. Obtained whilst a further 900 ml. aqueous distillate collected.
Fraction U4. Obtained as a result of continuing the steam distillation to complete exhaustion of the bark.

Four distillations were carried out in the above manner and the corresponding fractions amalgamated in the same way as the fractions resulting from the distillation of the scraped bark. The combined aqueous distillate was also worked up as in the previous series to provide three further fractions UD1, UD2 and UD3, the bulk of the aqueous distillate having been thereby reduced to about 5 litres.

Particulars of these fractions are given in Table A below :

TABLE A

Fraction.	Yield of oil, per cent. by weight. Expressed on the bark.	Expressed on total oil.	Character of Oil.
U1	0·016	6·9	Pale yellow ; rather weak odour.
U2	0·018	7·7	Similar to U1
U3	0·019	8·2	Similar to U1.
U4	0·034	14·6	Brownish-yellow, rather weak odour.
UD1	0·081	34·7	Pale golden-yellow ; fairly good odour.
UD2	0·048	20·6	Similar to UD1 in colour but having a pronounced odour of benzaldehyde in addition to cinnamic aldehyde.
UD3	0·017	7·3	
Total	0·233	100·0	

The seven fractions, after filtration through paper, were found to have the analytical constants given in Table B and there shown in comparison with the requirements of the British Pharmacopœia, 1932.

The last fraction had a pronounced almond-like smell and probably contained benzaldehyde.

It will be seen that none of the fractions conforms to all the British Pharmacopœia requirements, and a comparison of these results with those obtained for the scraped bark already described indicates that the possibility of compounding a British Pharmacopœia oil by mixing a number of the fractions is very remote. The quantities of the various fractions were insufficient to permit of trial mixtures being made.

The terpene content of the oils from the unscraped bark is very high as shown by the high optical rotation. Doubtless this could be reduced by further fractional steam distillation, but this would reduce the yield of oil to an uneconomic level.

TABLE B

Fraction.	U1.	U2.	U3.	U4.	UD1.	UD2.	UD3.	Requirements of B.P. 1932.
Specific Gravity at 15·5/15·5° C.	0·9177	0·9393	0·9569	0·9732	1·0305	1·0440	1·0472	1·000 to 1·030
Optical Rotation α_D22° C.	−8·94°	−8·55°	−7·26°	−5·97°	−2·15°	−0·75°	−0·60°	0° to −2° (20°C)
Refractive Index, n_D20° C.	1·5152	1·5292	1·5409	1·5429	1·5890	1·6040	1·6045	1·565 to 1·582
Cinnamic aldehyde (Hydroxylamine method) w/w *per cent.*	30·2	39·4	46·3	41·9	76·3	87·1	93·7	50 to 65
Solubility in 70 per cent. alcohol at 15·5° C.	Insol. in 10 vols.	Insol. in 10 vols.	Insol. in 10 vols.	Insol. in 10 vols.	Soluble in 2·1 vols. Slight opalescence	Soluble in 1·7 vols. Slight opalescence	Soluble in 1·8 vols. Slight opalescence	Soluble in 3 vols. with not more than slight opalescence

Summary

It was not found possible to produce oil from the samples of cinnamon bark which would conform to the requirements of the British Pharmacopœia, 1932, either by fractional steam distillation or by subsequent mixing of the fractions. In the case of the scraped bark in obtaining an oil soluble in 3 volumes of 70 per cent. alcohol it was found that at least 71 per cent. of cinnamic aldehyde was present, and even this oil did not conform to the British Pharmacopœia as regards optical rotation. By mixing certain fractions of oil obtained from this bark and raising the eugenol content to 10·8 per cent. v/v, by the addition of eugenol, a mixed oil was obtained, amounting to 87·5 per cent. (by weight) of the total oil, conforming in all respects excepting the optical rotation to the requirements of the British Pharmacopœia.

The unscraped bark was much inferior to the scraped bark both as regards the yield and the quality of the oil.

Conclusions

It would appear from the examination of the present samples of cinnamon bark from the Seychelles that the chief obstacle to the production of an oil conforming to the requirements of the British Pharmacopœia is a deficiency of eugenol in the oil compared with the Ceylon product. This difference may be due to climatic and soil conditions, or to the difference in age of the two barks when distilled.

It is known that Seychelles cinnamon leaf oil is richer in eugenol and poorer in cinnamic aldehyde than the corresponding oil from Ceylon, and as no question of differing ages of leaves arises here,

the indication is that a different balance of the eugenol and cinnamic aldehyde as between leaf and bark may be a natural result of different conditions of growth in the two places.

On the other hand, bark of the nature of that now examined, presumably collected from wild plants, is much older than the material used in Ceylon. The question of whether the amount of eugenol present in the bark oil varies with the age of the bark can only be settled by examining oil obtained from bark of various ages; it is, therefore, recommended that consideration should be given in the Seychelles to the advisability of submitting samples of such bark to the Imperial Institute for investigation on these lines.

NOTES

Minor Forest Products in Mysore.—In view of the potential value of the minor forest products in Mysore, Dr. M. N. Ramaswamy was commissioned by the Mysore Government to examine the question of "more organised collection and better utilisation" of these products. According to his report, which was published at the end of last year (*Minor Forest Products in Mysore*, published by the Government Press, Bangalore), Dr. Ramaswamy surveyed a large number of minor forest products and made recommendations with a view to their further exploitation.

One of the first products to be considered was sandalwood, which in many respects means more to the Forest Department than any other forest product. In view of the decreasing demand for sandalwood oil for medicinal purposes and its gradual replacement in perfumery by oils from other sources, the author suggests that increased use of the wood should be encouraged by suitable propaganda and that uses be found for the spent wood from the distilleries.

The three chief tanstuffs of Mysore are "tangadi" (*Cassia auriculata*), "kakke" (*C. fistula*), and myrobalans (*Terminalia chebula*). Of these "tangadi" is the most important, being responsible, so it is claimed, for the good reputation of the "Bangalore quality" of kips, which are tanned with this material. But of recent years "tangadi" has had to meet serious competition from wattle bark, which has the advantage over the Mysore material in many respects, other than of colour. One way suggested of meeting this competition from imported wattle bark is to grow the trees in Mysore. It is stated that there is enough evidence to show that the wattle tree can be grown in this part of India. Another method is to take technical measures to improve the properties and utilisation of "tangadi." For example, this bark might be blended with some inert material so that the resulting tannage would give to the finished leather the same, or higher, increase in

weight as wattle bark does. So far, this is only a suggestion which might be considered by the Department of Industrial Planning and Co-ordination. A more practicable scheme would be to make an extract of "tangadi," thereby freight charges per unit of tannin would be considerably reduced. The most fruitful line of approach to give immediate and practical results is considered to be administrative action whereby the utilisation and marketing of this bark could be improved on existing practice. Two specific methods are proposed. The suggestions made regarding "tangadi" also apply to "kakke." The departmental collection of myrobalans is advocated and a trial in Hassan is suggested. Such a trial was carried out in 1928 and showed a small profit.

Regarding drugs the author recommends that large-scale cultivation of cinchona, pyrethrum and derris should be undertaken, preliminary trials having shown that these can be grown successfully in Mysore. It would also be useful to carry out a survey of indigenous drugs with a view to supplying Government institutions with their requirements. Gardens for the cultivation of herbs should also be established. The production of essential oils should be encouraged and experimental work carried out at the Sandalwood Oil Factory, the Government Soap Factory, or the Forest Research Laboratory. The cultivation of geranium, vetiver and peppermint should be extended immediately. The production of crude lac should be increased to 20 tons per annum and personnel should be trained for this work. Honey and beeswax should be further exploited.

The two chief oilseeds showing most promise of commercial importance are "dhupa" (*Vateria indica*) and tung (*Aleurites montana* and *A. fordii*). In the past, considerable work has been carried out on the former but the author considers the problem of its extended utilisation should be re-examined by the Board of Industrial and Scientific Research. Small tung plantations have already been established near Hassan and these should be extended. Bamboos are already being used as a paper-making material. Their suitability as a raw material for rayon should be investigated as well as their use for reinforcing cement concrete constructions.

The Report makes interesting reading and gives a picture of the minor forest products available in Mysore. The carrying out of at least some of the author's recommendations should result in making the State less dependent upon imported materials and in adding to the wealth of her people.

G. T. B.

Investigation Work of the Agricultural Department, Antigua.—The following half-yearly Report on Investigational Work performed by the Agricultural Department, Antigua, for the period July to December, 1945, has been sent to the Imperial Institute by the Agricultural Superintendent.

Grass Experiments

(1) Varietal Experiment with Elephant Grass, Guinea Grass, Guatemala Grass and Uba Cane. Lay-out two 4 × 4 Latin Squares. The experiment was planted on 11/10/45. The plots of Elephant Grass and Guinea Grass were readily established but germination of the other plots was poor especially in the case of Guatemala Grass. The Elephant and Guinea Grass plots were reaped on 21/12/45, the yields of green fodder being 10·1 and 5·96 tons per acre respectively.

(2) Varietal and Manurial Experiment with the four fodder crops listed above. Lay-out one 4 × 4 Latin Square with half plots for no manure versus 2 cwt. nitrate of ammonia per acre.

(3) Manurial experiment with Elephant Grass. Lay-out two 4 × 4 Latin Squares, the manurial treatments under investigation being:

(1) Nil.
(2) 2 cwt. sulphate of ammonia per acre.
(3) 1 cwt. superphosphate per acre.
(4) 2 cwt. sulphate of ammonia and 1 cwt. superphosphate per acre.

Experiments 2 and 3 were not ready for reaping during 1945 but the results will be available for recording in the Annual Report for 1946. In these experiments with fodder grasses the final results will depend on the total yields over a long period including several cuttings, and it is probable that during such a period certain grasses will have been reaped more often then others—giving a greater annual yield though possibly a smaller yield for each individual period of reaping.

Sugar Cane Experiments

Seven Varietal Experiments, seven Varietal Observation Experiments, five Cultural and two Manurial Experiments for the 1947 crop were planted during the period under review.

Observations on Diseases of the Oil Palm in the Belgian Congo.—In the spring of this year, Dr. C. W. Wardlaw, Professor of Cryptogamic Botany at Manchester University, and formerly of the Low Temperature Research Station at the Imperial College of Tropical Agriculture, Trinidad, visited oil palm plantations in the Belgian Congo to make a survey of the present disease situation and to advise regarding control measures and scientific investigations. The report on his findings which appears under the above title, and which was written (May 1946) while the author was still in the Congo, has been issued privately in mimeographed form, illustrated with an excellent series of photographs, by the United Africa Company Limited at whose invitation the visit was made. While the report does not appear to be generally available, it is stated

that "copies are being distributed to those who, it is felt, will be interested and to whom these 'Observations' will prove of value."

The oil palm was studied in two main zones, the Southern areas of Lusanga and Brabanta, and the Northern main Congo River areas of Alberta, Yaligimba and Elisabetha. In both zones the incidence of disease was found to be serious. Of diseases observed the most important undoubtedly seems to be a wilt disease which the author suggests has hitherto not been described. Incidentally, Professor Wardlaw has published already a preliminary account of his observations on this wilt disease of *Elaeis guineensis* Jacq. (*Nature*, 1946, 158, 56). It is probable that wilt disease is of long standing though its economic effects have only become apparent more recently. While the present findings are naturally tentative, based as these are on a brief tour of two months' duration, it appears that wilt is caused by a soil fungus, entering at the base of the stem, and that although ultimately death will occur, the upward spread of the disease often takes place only over a number of years. The apparent toleration to wilt shown by the oil palm is of considerable economic value.

Next in importance seem to be physiological ailments. Professor Wardlaw uses the term "plant failure" for what is tentatively regarded as an extreme form of physiological disease, probably due to nutritional deficiencies, and in this connection the extreme form is likely to be the condition known as "yellowing disease" in Nigeria, preliminary studies regarding the control of which have been described in the *Annual Reports of the Oil Palm Research Station, Nigeria.* Other abnormal conditions, seemingly of lesser importance, but apparently of the same nature, are usually manifest in leaf symptoms.

Additional diseases observed are bud rot and crown rot, the symptoms of which are described as reminiscent of the bud rot of coconut palms due to *Phytophthora palmivora*; patch yellow, apparently an air-borne fungal disease due to a species of *Fusarium*; a *Fomes* rot, which is described as forming a deadly combination when it occurs in conjunction with wilt disease; *Rigidoporus microporus*, specimens of which were observed on palm trunks at one place; unspecified trunk rots; and a root disease. Trunk rots appear commonly to be secondary to insect tunnelling.

Much of the matter in this report is occupied with consideration of the need for a comprehensive investigation of the conditions studied; with an outline for a scheme of research; and with suggestions of practical control measures which might be adopted in the plantations pending the accumulation of more complete knowledge of these oil palm diseases.

Professor Wardlaw's studies are of major importance, and will serve to focus attention on oil palm diseases and to stimulate urgent consideration of the need for further provision for research on the oil palm in West Africa. Doubtless wilt disease is present in

British territories, in fact the photographs in this report illustrating stages in the development of wilt symptoms in the leaves of mature palms appear to be all too familiar. Without, however, in any way questioning the value of a review of this disease situation by a scientist of the calibre of Professor Wardlaw, it is only fair to point out that the need for further research on the oil palm in Africa has long been recognised by workers on the spot. In this connection it seems appropriate to quote from paragraph 5 of the introduction to the *Fifth Annual Report, Oil Palm Research Station, Nigeria, 1943-44* (Department of Agriculture, Nigeria, 1944, mimeographed).

> "The problems continually coming to light stress the need for further staff and equipment with which to tackle them. Among the lines of work urgently requiring study are a thorough investigation of . . . . ; physiological studies on suspected mineral deficiencies, on photosynthesis and on general metabolism ; and pathological studies of diseases occurring in the nurseries and in the field."

E. H. G. S.

BOOK REVIEWS

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

AN INTRODUCTION TO TEXTILE BLEACHING. By J. T. Marsh, M.Sc., F.R.I.C., F.T.I. Pp. xiii + 512, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Chapman and Hall, Ltd., 1946.) Price 32s.

This book, which deals chiefly with the occurrence and properties of the various textile fibres and the methods adopted for their purification, introduces the textile bleacher to the scientific principles underlying this very old trade, and as the author says in his preface, "The chief aim of the present book is to help the younger technologists, particularly those just entering the textile industry."

The text is divided into six parts. The first part occupying a fifth of the book deals quite fully with the various natural and synthetic fibres, their chemistry and physical properties. Part Two deals with wetting and detergency and gives a good theoretical and practical account of water softening, an important subject in bleaching, and the use of alkalis, buffers, wetting agents, detergents, etc. Parts Three and Four deal with the scouring and bleaching of the cellulosic and animal fibres respectively, whilst Part Five considers the drying of textiles. Part Six would be a welcome book on its own as it deals very fully with the practical determination of extent of "damage" to cellulosic and protein fibres.

The book satisfies a real need in supplying a theoretical background to the principles and developments in textile bleaching.

Adequate illustrations are given and the book can be recommended to the industry as a whole.

G. E. B.

The New Genetics in the Soviet Union. By P. S. Hudson and R. H. Richens. Pp. 88, $9\frac{3}{4} \times 7\frac{1}{4}$. (Imperial Agricultural Bureaux, Central Sales Branch, Penglais, Aberystwyth, 1946.) Price 6*s*.

This publication sets out to give geneticists in this country a concise exposition of the state of genetics in the Soviet Union at the present time.

A new genetics has arisen, mainly under the leadership of Lysenko and Prezent; it is still very young, appearing in the 1930's and becoming prominent only in about 1940; it remains to be seen whether it will flourish or whether it will subside, though it is stated that there are signs that it has already passed its zenith. Plant breeders and agriculturists, whose aim is to obtain the best practical results, seem to be the main supporters of the school and there is evidence that it is regarded somewhat coldly by many Russian biologists.

The school is non-mendelian and is an attempt to place genetics on a footing with dialectical materialism, the official philosophy of the Soviet Union.

The paper deals with matters rather off the direct line of genetics because as the authors explain, " Purely scientific matters are so entangled in philosophical, historical and psychological issues that an investigation confined to the Russian facts and theories alone would shed but a feeble light on the system as a whole."

Psychology plays a very prominent part in the new genetics which uses the following three methods of alogical discourse:

(*a*) Appeal to accepted authorities, including Dialectical Materialism, Darwin, Mičurin, Timirjazev, Burbank, Lysenko:

(*b*) Criticism of views referred to as " heretical," which include: Metaphysics, Vulgar materialism, Capitalism, Fideism, Fascism, Abiologism, Lamarckism: and

(*c*) Analyses of the state of mind of those authors whose views are under consideration.

The elevation of Darwin to a state of almost supreme authority in the sphere of genetical science is one of the most unusual features of the new school. It was achieved, by Prezent, by associating Darwin with dialectical materialism and consequently Russian Darwinism is by no means identical with Darwinism as understood by biologists in most other countries.

Nor does the third method of discourse strike a happy note to the ears of geneticists accustomed to analysing theories on their own merits or demerits.

This paper should be of considerable value in clarifying the

position of Russian genetics and the authors are to be congratulated on a most useful publication.

An African Survey. A Study of Problems arising in Africa South of the Sahara. By Lord Hailey, G.C.S.I., G.C.I.E. Second Edition. Pp. xxviii + 1,837, $8\frac{1}{2} \times 5\frac{1}{2}$. (London, New York, Toronto: Geoffrey Cumberlege, Oxford University Press, 1945.) Price 35*s*.

A review of the first edition of Lord Hailey's historic study of African problems appeared in this Bulletin, 1939, **37**, 72. The publication of a second edition is welcome, as the work is thus made available again, but no great changes seem to have been made in the original script since the survey was first published in 1938. Changes appear to be confined to minor alterations in the text without any alteration in the pagination. Thus this new edition is virtually a reprint, and no attempt seems to have been made to bring the matter up to date, which perhaps would have been quite impossible without a complete re-study in the field.

It is felt, however, that some brief foreword to this second edition might have been provided defining its scope. Regarding corrections it is noted that Chapter II on page 18 is still called Chapter I, an apparent unnecessary repetition of a mistake in the printing of the first edition.

E. H. G. S.

DDT the Synthetic Insecticide. By T. F. West, M.Sc., Ph.D. (Lond.), F.R.I.C., and G. A. Campbell, M.Sc. (Leeds), F.R.I.C. Pp. xii + 301, 9×6. (London: Chapman and Hall, Ltd., 1945.) Price 21*s*.

When the preparation and properties of DDT were first made public, they received a publicity in the press which was probably as great as had ever been devoted to any substance that had up to that time been isolated by man. Unfortunately, this publicity tended to give the impression that here was a material which was the answer to every problem of insect attack and that man's troubles in that direction had in all probability disappeared for ever. Attempts were made to modify this view which had gained a firm hold on the public and was creating considerable difficulty to the scientist, but nothing that has so far been published has done, or can do, so much to help us see this new insecticide in its correct perspective as this book which so ably summarises the present knowledge of a most important insecticide.

In addition to the history and development of the substance, this work covers a very wide field, including the manufacture and chemistry of DDT; its toxic manifestations; its use in paints, textiles and paper; its insecticidal value against human lice, mosquitos, household and other pests affecting men and animals;

its value in controlling plant pests; the effect of its use upon beneficial insects and its toxicity towards plant growth. References to the literature are given at the end of each chapter.

In an Epilogue to the book the authors review some of the limitations and possibilities of this insecticide and give it as their view that, although DDT has opened the field for many similar insecticides, it has probably come to stay for a long time and is worthy of experimentation in many fields. Whether DDT is to stay or not, everyone interested in synthetic insecticides, be he scientific or not, should read this book from cover to cover in order to obtain a true picture of the results obtained with the material up to the autumn of 1945.

H. E. C.

Economic Geography of Canada. By A. W. Currie, Dr. Com. Sc. (Harvard). Pp. xiv + 455, $8\frac{1}{8} \times 5\frac{3}{4}$. (Toronto: The Macmillan Company of Canada Limited; London: Macmillan and Company, Limited, 1945.) Price 16s.

The worst thing about this book is the accuracy of its title, which will undoubtedly doom it to an honoured place in the reference library. The layman, who was certainly in the author's mind when he wrote it, will probably miss it altogether. "The layman is referred to a few elementary texts," says the author, "and the expert to numerous publications." If the layman does stumble across a copy, he will probably enjoy it as much as he will have enjoyed, for example, the solid but attractively prepared fare of Mr. Arthur Bryant's historical surveys.

The books are alike in that they are written in a simple style which aids the concentration of the reader. Dr. Currie makes free use of repetition; explanations are plentiful and neat, sharply focussed little word pictures are introduced unostentatiously when the interest of the general reader might flag. Such phrases as "It is assumed that the reader knows something of the main wind systems of the planet," if left unexplained, might well interrupt the honest layman. But as the author immediately explains that he means "at the Equator the air is warmed and rises . . . the trade winds blow in to take its place . . .," the real enjoyment of reading is not interrupted. One can almost hear the Eskimo women scrunching the bones of the little dovekies or see Jack Frost silently passing by the fruit trees on the high ground of the Annapolis farm to attack those in false security in the warmth of the valley.

Dr. Currie claims that this book supplies a much-needed want. "Existing publications on the geography of North America give scant attention to the British territories, and what little is contained is often inaccurate. More important, Canada and Newfoundland are separate political entities and the proper solution of many of their pressing problems presupposes an understanding of their physical environment. A knowledge of what these Dominions

have in the way of natural resources, of how these are being used at present, and of attempts towards the better use of them, is a pre-requisite of intelligent national planning for the future."

For the purpose of this book, Canada is divided into seven physiographic regions, each of which is dealt with from the mists of its geological past; the clevages of economic interest between region and region are discussed and possible and probable lines of economic development are outlined, making it clear that Canada need not remain "that strip of territory north of the U.S.A." A reading of the chapter on "The Tundra," together with the reports of the recently completed "Operation Musk-on," should oust from the classroom for ever any reference to "The Barren Grounds" of Northern Canada.

R. C. H. W.

BEES AND HONEY. By G. A. Carter, B.Sc., A.R.I.C. Pp. 114, $7\frac{1}{2} \times 5$. ("Bee Craft," Bracken Dene, Manor Way, Petts Wood, Kent, 1946.) Price 4s.

In spite of its small size this new book on beekeeping is packed with useful information much of which is new, at any rate, to books on beekeeping.

A most interesting chapter, Photosynthesis, Nectar and Honey, deals with several interesting and unusual topics such as vitamins in honey, traces of at least six of which are stated to occur; and a subject with little practical importance to the beekeeper but considerable interest, the effect of ultra-violet light on honey. Under certain circumstances honey exhibits a light blue fluorescence topped by a white zone, the intensity of the fluorescence is dependant upon the water content of the honey. True honey can be distinguished by this means from synthetic honey and it is also possible to determine approximately the origin of a true honey.

Chapters on British nectar and pollen plants, fermentation and enzymes, fruit sprays and bees, and the mind of the bee together with more formal chapters on beekeeping combine to make this a most interesting and instructive volume.

I. C. S.

FERGUSON'S CEYLON DIRECTORY FOR 1946. Compiled and Edited by the Staff of the *Ceylon Observer*. Pp. vii + 1,396, $8\frac{3}{4} \times 5\frac{1}{2}$. (Colombo: The Ceylon Observer Press, 1946.) Price 35s.

This Directory is in its 88th year and the first post-war edition has been brought up well to the pre-war standard.

Of the three Sections which the book contains, Part I gives a valuable collection of particulars on a variety of subjects including the official public services, banking and commerce, a mercantile list, a guide to branded products, planting companies, institutions and planting associations, and a review of the main agricultural products of the Island. Part II comprises an Estates Directory

arranged under districts in alphabetical order giving details of crops grown on each estate and their acreage, together with an index to tea, rubber and coconut estates with their Sinhalese and Tamil names. Part III is a general directory of addresses.

There is a good general index and a map showing districts where rubber, tea and coconuts are produced, the location of Botanic Gardens and Experiment Stations and the principal roads and railways. The Directory will be extremely useful to firms and others interested in Ceylon products.

JOURNAL OF THE BRITISH GRASSLAND SOCIETY, 1946. Vol. I, No. 1. Pp. 88, $9\frac{1}{2} \times 7\frac{1}{4}$. Obtainable from the Society, Agricultural Research Building, Penglais, Aberystwyth, Wales. Annual Subscription, 10*s*.

The British Grassland Society was founded in 1945 and is an outcome of the necessary attention that is being given by agricultural scientists to problems connected with grassland husbandry. Among its objects is the publication of information relating to this subject, and in fulfilment of this function the Society has started publishing a journal. During the present year it is intended to issue two numbers, the first of which appeared last March.

In this issue will be found papers written by authorities on: the output of pasture and its measurement; the rôle of silage in grassland management; observations on the occurrence of leatherjackets in re-seeded grassland in Yorkshire; and the productivity of reclaimed upland areas in Montgomeryshire.

This journal is well printed and of attractive appearance, being illustrated with excellent plates. It should prove of interest to all those concerned with grassland husbandry.

G. T. B.

INTO THE FREEZER—AND OUT. By Donald K. Tressler, Ph.D., Clifford F. Evers, B.S., and Lucy Long. Pp. viii + 223, $8 \times 5\frac{1}{2}$. (New York: The Avi Publishing Company, Inc., 1946.) Price $2.50 (Foreign price $2.75).

The preservation of food in cold storage has been carried out for a number of years, and the use of refrigerators in the home has been practised for a considerable period. From this cold storage method has been evolved of recent years the process in which the food is not merely chilled but is frozen. By this means it is now possible to keep perishable foodstuffs for much longer periods than by cold storage.

This book, which deals with the recent freezing process is written in a popular strain, and is intended primarily for the housewife. In it is given an indication of the possibilities of this process of preservation and its advantages over cold storage, not only as regards a longer retention of freshness, but also better nutritive

value. Practical details are included with a view to obtaining the best possible results from this freezing process, while instructions are given on the preparation for the table of foods which have been preserved in this way. A number of excellent plates enhance the appearance of the book, which should not only appeal to those living in towns, but should also be of interest to others in isolated districts.

G. T. B.

BIBLIOGRAPHY

Compiled by Miss R. M. Johnson

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the three months May-July 1946.

The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1. Applications for the Dominion and Indian Governments publications may be made to the Offices of the High Commissioners or Agents-General in London.

AGRICULTURE

General

Annual Report of the Department of Agriculture and Stock, Queensland, for 1944-45. Pp. 40, 13 × 8. (Brisbane: Government Printer, 1945.)

A Ten-Year Plan of Development and Welfare for Nigeria, 1946. *Sess. Pap. No.* 24 of 1945. Pp. 157, 13 × 8. (Lagos: Government Printer, 1946.)

Report of the Department of Agriculture and Fisheries, Palestine, for the year ended March 31, 1945. Pp. 16, 9½ × 6½. (Jerusalem: Government Printer, 1946.) Price 100 Mils.

Annual Report of the Department of Agriculture, Seychelles, for 1944. Pp. 7, 8½ × 5½. (Mahé: Government Printing Office, 1945.)

Annual Report of the Veterinary and Agricultural Department, Swaziland, for 1944. Pp. 35, 13 × 8. (Swaziland: Veterinary and Agricultural Department, 1946.) Mimeographed.

Annual Report of the Department of Agriculture, Uganda, for the period July 1, 1944, to June 30, 1945. Part I. Administrative. Pp. 43, 9½ × 6. (Entebbe: Government Printer, 1946.) Price Shs. 2/50.

Agriculture at the End of the War. Report of the Department of Agriculture, Union of South Africa, for the year ended August 31, 1945. By C. H. Neveling. *Frmg. S. Afr.*, 1946, **21**, No. 240, 131-203.

Report of the Administrator of Agricultural Research, United States Department of Agriculture, 1945. Pp. 238, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Includes the reports of the following agencies of the Administration: The Bureaux of Agricultural and Industrial Chemistry; Animal Industry; Dairy Industry; Entomology and Plant Quarantine; Human Nutrition and Home Economics; Plant Industry, Soils, and Agricultural Engineering; and the Office of Experiment Stations.

Report of the Secretary of Agriculture, United States Department of Agriculture, 1945. Pp. 167, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 30 cents.

Sixty-fourth Annual Report of the New York State Agricultural Experiment Station, Geneva, for the year ended June 30, 1945. Pp. 74, 9 × 6. (Geneva, N.Y.: Agricultural Experiment Station, 1945.)

Shaping the Future of Hawaii's Agriculture. Report of the University of Hawaii Agricultural Experiment Station for the Biennium ended June 30, 1944. (Honolulu: University of Hawaii, 1945.)

Fifty-fifth Annual Report of the Agricultural Experiment Station, Pullman, Washington, for the year ended June 30, 1945. (*Bull. No.* 470.) Pp. 167, 9 × 6. (Pullman, Washington: Agricultural Experiment Station, 1945.)

Programme of Social and Economic Development in the Zanzibar Protectorate for the Ten-Year Period, 1946 to 1955. *Sess. Pap. No.* 1 of 1946. Pp. 35, 13 × 8. (Zanzibar: Government Printer, 1946.)

Annual Report of Kizimbani Experiment Station, Department of Agriculture, Zanzibar, for 1944. Pp. 55, 13 × 8. (Zanzibar: Department of Agriculture, 1945.)

The Soil

Seasonal Fluctuations of Soil Moisture and Nitrate in a Humid Tropical Climate (Trinidad, B.W.I.). By F. Hardy. *Trop. Agric., Trin.*, 1946, **23**, No. 3, 40-49.

Report of the Water Conservation and Irrigation Commission, New South Wales, for the year ended June 30, 1945. Pp. 32, 13 × 8. (Sydney: Government Printer, 1946.) Price 2*s*.

Report of the Chief of the Soil Conservation Service, United States Department of Agriculture, for the year ended June 30, 1945. Pp. 55, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 15 cents.

Pests—General

(For Insecticides of Vegetable Origin, see p. 222.)

Insecticidal Dusts Against Flea Beetles. Report from the Conference of Advisory Entomologists. By H. W. Miles, with the assistance of D. J. Finney and F. J. Anscombe. *Agriculture*, 1946, **53**, No. 2, 58-66.

Tests on Clothing Impregnated with DDT as an Anti-Louse Measure. By A. J. Musgrave. *Bull. Ent. Res.*, 1946, **37**, Pt. 1, 43-56.

DDT and Its Effect on Fish and Wild Life. By C. Cottam. *J. Econ. Ent.*, 1946, **39**, No. 1, 44-52.

Foodstuffs—General

Tables of Representative Values of Foods Commonly used in Tropical Countries. By B. S. Platt. *Spec. Rep. Series No.* 253, *Med. Res. Coun.* Pp. 41, 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 9*d*.

The Effect of Storage on Carotene of Plant Extracts. By A. R. Kemmerer and G. S. Fraps. *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 4, 457-458.

Beverages

Swollen Shoot of Cacao. How to Recognise and Control. Pp. 20, 9½ × 6. (Tafo, Gold Coast: Cacao Research Institute, 1945.) A memorandum prepared by the West African Cacao Research Institute at the request of the West African Cacao Research and Survey Advisory Committee, on the symptoms of swollen-shoot disease, with an evaluation of the control measures applied between 1940 and 1943 by the Department of Agriculture, Gold Coast.

Fifth Annual Report of the Indian Coffee Board, Bangalore, 1944-45. Pp. 57, 9½ × 6½. (Bangalore: Indian Coffee Board 1945.) Price Re. 1 As. 8.

Growth and Bearing Habits of *Coffea arabica* in Kenya and in Southern India. By R. W. Rayner. *E. Afr. Agric. J.*, 1946, **11**, No. 4, 251-255.

The Problem of Nematode Control in Tea Plantations. By C. M. Gadd and C. A. Loos. *Tea Quart.*, 1946, **18**, Pt. 1, 3-11.

A Review of Rolling Methods in Tea Manufacture. By J. Lamb. *Tea Quart.*, 1946, **18**, Pt. 1, 19-29.

Cereals

Maize Growing for Grain. *N.Z. J. Agric.* 1946, **72**, No. 3, 281-299.

Corn Starch—A Versatile Commodity. By N. F. Kennedy. *Food Industr.* 1946, **18**, No. 5, 99-102, 220, 222. Discusses the properties and the numerous industrial applications of the product.

Preliminary Report on Rice Growing on Guadalcanal, British Solomon Islands. By O. M. Ojala. *Agric. J. Fiji*, 1946, **17**, No. 1, 7-8.

Results of Some Wheat Experiments in the Northern Province, Tanganyika Territory. By N. R. Fuggles-Couchman. *E. Afr. Agric. J.*, 1946, **11**, No. 4, 231-237.

The Spontaneous Heating of Stored Cereals. Nature and Causes of the Phenomenon. By T. A. Oxley. *Milling*, 1946, **106**, No. 18, 380-384. Reprinted in slightly condensed form from the *Royal College of Science Journal.*

Sugar

Sugarcane Varieties Produced by the Sugarcane Research Station, and their Value to the Sugar Industry of Mauritius. By G. C. Stevenson. *Bull. No.* 18, *Sugarcane Res. Sta. Mauritius.* Pp. 24, 9½ × 6. (Port Louis: Government Printer, 1946.)

The Yields of Sugar Cane in Barbados in 1945. By C. B. Foster. *Bull. No.* 5 (*New Series*), *Dep. Sci. Agric. Barbados.* Pp. 13, 9½ × 6. (Barbados: Government Printer, 1945.).

Some Factors Causing Dark-colored Maple Sirup. By F. W. Hayward and C. S. Pederson. *Bull. No.* 718, *N.Y. St. Agric. Exp. Sta.* Pp. 14, 9 × 6. (Geneva N.Y.: Agricultural Experiment Station, 1946.)

The Storage of Maple Sirup. By F. W. Hayward. *Bull. No.* 719, *N.Y. St. Agric. Exp. Sta.* Pp. 8, 9 × 6. (Geneva N.Y.: Agricultural Experiment Station, 1946.)

Root Crops

Studies on Sweet Potato Production in Texas. By R. E. Wright. *Bull. No.* 668, *Texas Agric. Exp. Sta.* Pp. 15, 9 × 6. (Texas: Agricultural Experimental Station, 1945.)

Contribution à l'Étude de la Toxicité du Manioc au Congo Belge. By L. Adriaens. *Mém. Inst. Colon. Belge, Sect. Sci. Nat. Méd.*, 1946, **13**, No. 4. Pp. 140, 9½ × 6. (Brussels: Institut Royal Colonial Belge, 1946.)

Fruits

Report of the National Fruit Trials, 1921-1944. By J. M. S. Potter, with a Foreword by H. V. Taylor. Pp. 56, 9¾ × 6. (London: Royal Horticultural Society, 1946.) Price 5*s*.

Ground Treatment as an Aid in Apple Scab Control. By D. H. Palmiter. *Bull. No.* 714, *N.Y. St. Agric. Exp. Sta.* Pp. 27, 9 × 6. (Geneva, N.Y.: Agricultural Experiment Station, 1946.)

Studies on Storage Scald of Apples. By R. M. Smock and F. W. Southwick. *Bull. No.* 813, *Cornell Agric. Exp. Sta.* Pp. 39, 9 × 6. (Ithaca, N.Y.: Agricultural Experiment Station, 1945.)

Cold Storage for Apples and Pears. By W. V. Hukill and E. Smith. *Circ. No.* 740, *U.S. Dep. Agric.* Pp. 61, 9 × 6. (Washington, D.C.:

Superintendent of Documents, Government Printing Office, 1946.) Price 15 cents.

Investigations on Some Fundamental Aspects of Citrus Propagation in Assam. By H. K. Nandi, S. C. Bhattacharyya and S. Dutta. *Indian J. Agric. Sci.*, 1945, **15**, Pt. 4, 191-200.

Currant Leaf Spot Control. By R. F. Suit. *Bull. No.* 709, *N.Y. St. Agric. Exp. Sta.* Pp. 13, 9 × 6. (Geneva, N.Y.: Agricultural Experiment Station, 1945.)

Control of Gooseberry Diseases. By R. F. Suit and D. H. Palmiter. *Bull. No.* 711, *N.Y. St. Agric. Exp. Sta.* Pp. 22, 9 × 6. (Geneva, N.Y.: Agricultural Experiment Station, 1945.)

Changes in Lemons During Storage as Affected by Air Circulation and Ventilation. By E. M. Harvey. *Tech. Bull. No.* 908, *U.S. Dep. Agric.* Pp. 32, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 10 cents.

Papaw Culture in Queensland. By G. W. J. Agnew. *Queensld. Agric. J.*, 1946, **62**, Pt. 4, 202-214.

Tree-Conditioning the Peach Crop. A Study of the Effect of Thinning and other Practices on Size and Quality of Fruit. By M. J. Dorsey and R. L. McMunn. *Bull. No.* 507, *Ill. Agric. Exp. Sta.* Pp. 425, 9 × 6. (Illinois: Agricultural Experiment Station, 1946.)

Control of Spur Blight of Red Raspberries. By R. F. Suit. *Bull. No.* 710, *N.Y. St. Agric. Exp. Sta.* Pp. 14, 9 × 6. (Geneva, N.Y.: Agricultural Experiment Station, 1945.)

Pearl Harbor. A Tomato Variety Resistant to Spotted Wilt in Hawaii. By K. Kikuta, J. H. Hendrix and W. A. Frazier. *Circ. No.* 24, *Hawaii Agric. Exp. Sta.* Pp. 4, 9 × 6. (Honolulu, T.H.: Agricultural Experiment Station, 1945.)

Report of the New South Wales Dried Fruits Board for 1944. Pp. 3, 13 × 8. (Sydney: Government Printer, 1945.) Price 4*d.*

Storage of Dried Fruit. Influence of Temperature on Deterioration of Apricots. By E. R. Stadtman, H. A. Barker, V. Haas and E. M. Mrak. *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 5, 541-543.

The Storage of Shelled Pecans. By F. R. Brison. *Bull. No.* 667, *Texas Agric. Exp. Sta.* Pp. 16, 9 × 6. (Texas: Agricultural Experiment Station, 1945.)

Vegetables

Asparagus Production in Hawke's Bay [New Zealand]. By T. Conway. *N.Z. J. Agric.*, 1946, **72**, No. 5, 495-500.

Spacing Affects Yield of Asparagus. By H. C. Thompson. *Bull. No.* 822, *Cornell Agric. Exp. Sta.* Pp. 8, 9 × 6. (Ithaca, N.Y.: Agricultural Experiment Station, 1945.)

Commercially Dehydrated Vegetables. Oxidative Enzymes, Vitamin Content and Other Factors. By M. F. Mallette, C. R. Dawson, W. L. Nelson and W. A. Gortner. *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 4, 437-441.

Fodders and Forage Plants

Riboflavin Content of Some Animal Feeds and Some Human Foods. By A. R. Kemmerer and G. S. Fraps. *Bull. No.* 671, *Texas Agric. Exp. Sta.* Pp. 18, 9 × 6. (Texas: Agricultural Experiment Station, 1945.)

Harvesting Chou Moellier Seed Crop. By G. K. McPherson. *N.Z. J. Agric.*, 1946, **72**, No. 2, 135-137.

The Feeding Value of Flax By-Products. II. Flax Shive. By R. H. Common. *Emp. J. Exp. Agric.*, 1946, **14**, No. 54, 71-74.

Protein Content and Yield of Grasses in the Wet Tropics as Influenced

by Seasonal Productivity, Frequency of Cutting and Species. By J. L. Schofield. *Queensld. J. Agric. Sci.*, 1945, **2**, No. 4, 209-243.

The " Blue " Grasses in Fiji. By B. E. Parham. *Agric. J. Fiji*, 1945, **16**, No. 4, 104-107.

The Horse-Chestnut as a Source of Food for Livestock. I. The Composition, Digestibility and Nutritive Value of Alcohol-extracted Horse-Chestnut Meal, Water-extracted Horse-Chestnut Meal and Horse-Chestnut Residue. II. The Value of Alcohol-extracted Horse-Chestnut Meal, Water-extracted Horse-Chestnut Meal and Horse-Chestnut Residue as a Partial Substitute for Cereals in the Rations of Bacon Pigs. By H. E. Woodman and R. E. Evans. *J. Agric. Sci.*, 1946, **36**, Pt. 1, 29-55.

Lespedeza. Culture and Utilization. By R. McKee. *Frms.' Bull. No.* 1852, *U.S. Dep. Agric.* Pp. 14, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 5 cents.

Millet. By P. S. Syme. *N.Z. J. Agric.*, 1946, **72**, No. 2, 117-121.

Methods of Making Potato Silage and Tests of its Feeding Value for Dairy Cows. By J. B. Shepherd, T. E. Woodward and C. G. Melin. *Tech. Bull. No.* 914, *U.S. Dep. Agric.* Pp. 14, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Oils and Oil Seeds

Review of Literature on Fats, Oils and Soaps. Report of the Literature Review Committee. By M. M. Piskur. *Oil and Soap*, 1946, **23**, No. 4, 113-123; No. 5, 151-167.

The Commercial Solvent Separation of Fatty Acids. By R. E. Kistler, V. J. Mucker-Reide and L. D. Myers. *Oil and Soap*, 1946, **23**, No. 5, 146-150.

Some Empire Vegetable Drying Oils. By G. T. Bray. *Paint Technol.*, 1946, **11**, No. 122, 51-57; No. 123, 97-101, 122.

Production et Utilisation des Oléagineux en Afrique. By P. H. Mensier. *Bull. Inst. Colon. Marseille, Mat. Grasses*, 1945, **29**, Nos. 11-12, 145-151.

Notes on the Cultivation of Coconuts. Compiled by the Department of Agriculture [Jamaica]. *J. Jam. Agric. Soc.*, 1945, **49**, Nos. 10-12, 210.

The Unknown Disease of the Coconut Palm in Jamaica. By R. Leach. *Trop. Agric., Trin.*, 1946, **23**, No. 3, 50-60.

Advances in Olive Processing Methods in California and Abroad. Paper Presented at the 1946 Olive Growers' Conference, Lindsay, Calif. By W. V. Cruess. *Fruit Prod. J.*, 1946, **25**, No. 8, 237-241.

Rape Seed Production. By N. H. Greaves. *N.Z. J. Agric.*, 1946, **72**, No. 5, 453-455. Describes the methods employed in the South Canterbury District, New Zealand.

The Composition of Sorghum Grain Oil (*Andropogon sorghum* var. *vulgaris*). By F. A. Kummerow. *Oil and Soap*, 1946, **23**, No. 5, 167-170.

The Tung Oil Industry [in the United States]: Growth and Prospects. By E. L. Rauber. *Nat. Paint Bull.*, 1946, **10**, No. 3, 5-6, 8-9, 12, 18. This article is reprinted from *The Chemurgic Digest.*

Essential Oils

Studies in Indian Turpentine. A Note on the Spent Turpentine. By Bharat Bhushan, K. C. Gulati and M. L. Joshi. *J. Indian Chem. Soc., Industr. News Ed.*, 1945, **8**, Nos. 3 and 4, 124.

A Note on the Essential Oil of Mustard in *Brassica* Species and *Eruca sativa*. By Ali Mohammad and Sultan Ahmad. *Indian J. Agric. Sci.*, 1945, **15**, Pt. 4, 181-183.

Fibres

Empire Cotton Growing Corporation. Progress Reports from Experiment Stations, Season 1944-1945. Programmes of Experiments, Season 1945-1946.

Pp. 142, 9½ × 6. (London: Empire Cotton Growing Corporation, 1946.) Price 3*s*.

The Periodic Partial Failures of American Cottons in the Punjab: Their Causes and Remedies. By R. H. Dastur. *Sci. Monogr. No.* 2, *Indian Cent. Cotton Comm.* Pp. 144, 9¾ × 7¼. (Bombay: Indian Central Cotton Committee, 1945.) Price Rs.5 As. 8.

Influence of Agronomic Treatments on Ginning Percentage in Punjab Cotton. By Mohammad Afzal, Sawan Mall Sikka and Abdul Jabbar Khan. *Indian J. Agric. Sci.*, 1945, **15**, Pt. 4, 184-190.

Fruiting and Shedding of Cotton in Relation to Light and other Limiting Factors. By A. A. Dunlap. *Bull. No.* 677, *Texas Agric. Exp. Sta.* Pp. 104, 9 × 6. (Texas: Agricultural Experiment Station, 1945.)

Benzene Hexachloride to Control Cotton Insects. By E. E. Ivy and K. P. Ewing. *J. Econ. Ent.*, 1946, **39**, No. 1, 38-41.

Technological Research 1938-44, The Indian Central Jute Committee. Research Results Recommended for Practical Application, being a Review of Some of the Work done from the Inception of the Technological Research Scheme up to October 31, 1944. By C. R. Nodder. Pp. 63, 9½ × 6. (Calcutta: Indian Central Jute Committee, 1946.) Price As. 14.

The Apparent Density of Jute Fibre and its relation to Spinning Quality. By B. K. Chakrabarti, C. R. Nodder and K. R. Sen. *Tech. Res. Mem. No.* 8, *Indian Cent. Jute Comm.* Pp. 27, 9½ × 6½. (Calcutta: Indian Central Jute Committee, 1945.) Price As. 12.

Jute Substitutes. By K. C. Basak. With an Appendix on Some Technological Aspects of Jute Substitutes. By C. R. Nodder. *Econ. Res. Bull. No.* 2, *Indian Cent. Jute Comm.* Pp. 48, 9½ × 6. (Calcutta: Indian Central Jute Committee, 1945.) Price As. 11.

The Over-All Specific Volume of Kapok. By W. H. Rees. *J. Text. Inst.*, 1946, **37**, No. 5, T121-T139.

La Fibre de Ramie, ses Propriétés, ses Qualités Textiles. By O. Roehrich and Bùi-Xuân-Nhuân. *L'Agron. Trop.*, 1946, **1**, Nos. 5-6, 261-289.

Observations on the Spacing of Sisal. By G. W. Lock. *E. Afr. Agric. J.*, 1946, **11**, No. 4, 247-250.

Paper-making Materials

The Relation of the Chemical Composition of Fibres to their Paper-making Properties. By J. M. Limerick and A. J. Corey. *Pulp Pap. Mag. Canada*, 1946, **47**, No. 4, 62-64, 84.

Production of Bleachable Sulphate Pulps from Rapid-Growth Douglas Fir. By J. S. Martin. *Pap. Tr. J.*, 1946, **122**, No. 22, 37-44.

Rubber

Investigations of Guayule (*Parthenium argentatum* Gray) in South Australia. By R. L. Crocker and H. C. Trumble. *Bull. No.* 192, *Coun. Sci. Industr. Res. Aust.* Pp. 44 + 12 plates, 9½ × 6. (Melbourne: Government Printer, 1945.)

Diseases of Cultivated Guayule and Their Control. By W. A. Campbell and J. T. Presley. *Circ. No.* 749, *U.S. Dep. Agric.* Pp. 42, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 15 cents.

Tobacco

Conditioning, Bulking and Grading Flue-cured Tobacco. By A. Hamilton. *Queensld. Agric. J.*, 1946, **62**, Pt. 4, 198-201.

Cigarette Tobacco in Northern Nigeria. By D. H. Baker. *Farm and Forest, W. Afr.*, 1945, **6**, No. 3, 161-162.

The Culture of Turkish Tobacco in Southern Rhodesia. By D. D. Brown. *Rhod. Agric. J.*, 1946, **43**, No. 1, 75-97.

Drugs

Ion Exchange Process for Extracting Cinchona Alkaloids. By N. Applezweig and S. E. Ronzone. *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 6, 576-579.

Cinchona in Uganda. By A. S. Thomas. *Emp. J. Exp. Agric.*, 1946, **14**, No. 54, 75-84.

Drug Plant Investigations [in Australia]. I. Progress Report. By C. Barnard and H. Finnemore. *J. Coun. Sci. Industr. Res. Aust.*, 1945, **18**, No. 4, 277-285. An account of the performance of plants producing the drugs morphine, hyoscine, atropine, hyoscyamine, ephedrine, digitalis and santonin in plot trials.

The Influence of Fertilizers on the Growth and Alkaloidal Content of *Hyoscyamus niger* Linn. By S. Prasad. *J. Amer. Pharm. Assoc., Sci. Ed.*, 1946, **35**, No. 4, 121-127.

Changes in the Morphine and Dry Matter Content of the Opium Poppy (*Papaver somniferum*) during the Maturation Period. By K. Loftus Hills. *J. Coun. Sci. Industr. Res. Aust.*, 1945, **18**, No. 4, 286-297.

À Propos de Médicaments Antilépreux d'Origine Végétale. III. Les Plantes Utiles du Genre *Strychnos*. By E. de Wildeman. Pp. 105, 9½ × 6½. *Mém. Inst. Colon. Belge, Sect. Sci. Nat. Méd.*, 1946, **13**, No. 5. (Brussels: Institut Royal Colonial Belge, 1946.)

À Propos de Médicaments Antilépreux d'Origine Végétale. IV. Des *Strophanthus* et de leur Utilisation en Médicine. By E. de Wildeman. Pp. 70, 9½ × 6½. *Mém. Inst. Colon. Belge, Sect. Sci. Nat. Méd.*, 1946, **15**, No. 4. (Brussels: Institut Royal Colonial Belge, 1946.)

Production, Concentration, Properties and Assay of the Antibiotic, Subtilin. AIC-106 *U.S. Dep. Agric.* Pp. 7, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Production of subtilin has been carried out by the use of culture media prepared from waste asparagus butts.

Miscellaneous Agricultural Products

Alcohol from Agricultural Commodities. By P. B. Jacobs. AIC-95, *U.S. Dep. Agric.* Pp. 77, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Mimeographed.

Cotton Wax. Properties and Constituents. By W. H. Tonn and E. P. Schoch. *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 4, 413-415.

Hop Culture in the Nelson District [New Zealand]. By N. J. Adamson. *N.Z. J. Agric.*, 1946, **72**, No. 2, 147-153.

Feeding Yeasts from Wood Sugar Stillage. By E. F. Kurth and V. H. Cheldelin. *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 6, 617-619. A comparative study made with the lesser-known strains of yeasts *Torula*, *Mycotorula* and *Hansenula*.

Studies on Rum. By R. Arroyo. *Res. Bull. No. 5, P. R. Agric. Exp. Sta.* Pp. 272, 9 × 6. (Puerto Rico: Agricultural Experiment Station, 1945.)

Livestock and Animal Products

Report of the Veterinary Director-General, Department of Agriculture, Canada, for the year ended March 31, 1945. Pp. 37, 9¾ × 6½. (Ottawa: King's Printer, 1946.)

The Keeping Quality of Australian Milk Powders. By C. C. Thiel. *J. Coun. Sci. Industr. Res. Aust.*, 1945, **18**, No. 4, 373-390.

Studies on Compressed Whole Milk Powder. By C. C. Thiel. *J. Coun. Sci. Industr. Res. Aust.*, 1945, **18**, No. 4, 391-406.

The South African Butter Industry. The Expansion of the Industry

between 1911 and 1945. By C. W. Abbott. *Frmg. S. Afr.*, 1946, **21**, No. 241, 251-258.

Experiments on the Manufacture and Storage of Ghee. By C. R. Barnicoat. *N.Z. J. Sci. Tech.*, 1945, **27**, No. 4, 309-319.

The Nutrition of Poultry. By A. M. Gericke. *Bull. No.* 260, *Dep. Agric. Un. S. Afr.* Pp. 52, 9½ × 6. (Pretoria: Government Printer, 1946.) Price 6*d*.

Poultry Diseases, their Prevention and Control. By L. D. Bushnell and M. J. Twiehaus. *Bull. No.* 326, *Kansas Agric. Exp. Sta.* Pp. 124, 9 × 6. (Topeka, Kansas: Agricultural Experiment Station, 1945.)

The Fisheries of British Honduras. Report by E. F. Thompson. *Bull. No.* 21, *Development and Welfare in the West Indies.* Pp. 32, 9½ × 6. (Bridgetown, Barbados: Advocate Company, 1946.) Price 10 cents.

A Study of Substitutes for Leather. By H. Salt. Pp. 101, 13 × 8. (London: H.M. Stationery Office, 1946.) Price 2*s*. 6*d*. Issued under the auspices of the Leather Substitutes Panel of the Substitutes Committee of the Advisory Council on Scientific Research and Technical Development, Ministry of Supply.

FORESTRY

General

Annual Report of the Imperial Forestry Institute, Oxford, 1944-45. Pp. 16, 8½ × 5½. (Oxford: Imperial Forestry Institute, 1946.)

Report of the Director of Forests, Queensland, for the year ended June 30, 1945. Pp. 5, 13 × 8. (Brisbane: Government Printer, 1945.)

Report of the Department of Lands and Forests, Nova Scotia, for 1945. Pp. 118, 9¾ × 6½. (Halifax, N.S.: King's Printer, 1946.)

Annual Report of Forest Administration in the United Provinces for 1944-45. Pp. 47, 9½ × 6¼. (Allahabad: Superintendent, Printing and Stationery, 1946.) Price As. 10.

Annual Report of the Forest Department, Kenya, for 1944. Pp. 13, 9¾ × 6. (Nairobi: Government Printer, 1946.)

Forestry in Kenya. By R. M. Graham. *Emp. For. J.*, 1945, **24**, No. 2, 156-175.

Statement of Policy of the Forest Department, Sierra Leone. *Sess. Pap. No.* 2 of 1946. Pp. 14, 9½ × 6. (Freetown: Government Printer, 1946.) Price 1*s*. 6*d*.

Replanting of Felled Coniferous Woodland in Relation to Insect Pests. *Leafl. No.* 25, *For. Comm.* Pp. 8, 9½ × 6. (London: Forestry Commission, 1945.)

Adelges cooleyi, an Insect Pest of Douglas Fir and Sitka Spruce. *Leafl. No.* 2 (Revised), *For. Comm.* Pp. 4, 9½ × 6. (London: Forestry Commission, 1945.)

Two Leaf-cast Diseases of Douglas Fir. *Leafl. No.* 18 (Revised), *For. Comm.* Pp. 8, 9½ × 6. (London: Forestry Commission, 1946.) The two diseases are caused by *Rhabdocline pseudotsugae* and *Phaeocryptopus gäumannii.*

Conifer Heart Rot (*Fomes annosus*). *Leafl. No.* 5 (Revised), *For. Comm.* Pp. 7, 9½ × 6. (London: Forestry Commission, 1946.)

The Biology, Economic Importance and Control of the Pine Bark Weevil (*Aesiotes notabilis* Pasc.). By A. R. Brimblecombe. *Bull. No.* 14, *Queensld. For. Serv.* Pp. 88, 9½ × 7¼. (Brisbane: Government Printer, 1945.). Reprinted from *Queensld. J. Agric. Sci.*, 1945, **2**, No. 1. This insect is common in extensive plantations of hoop pine, *Araucaria cunninghamii.*

Chemistry of Western Pines. Distribution and Nature of Acetone Soluble Extractives in Ponderosa Pine. By A. B. Anderson. *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 4, 450-454. Western pines include *Pinus ponderosa, P. monticola* and *P. lambertiana.*

Balsa as a Commercial Crop. By T. H. Parsons. *Trop. Agric., Ceylon*, 1945, **101**, No. 3, 120-126.

Gums and Resins

" Gum Taminda," a New Substitute for Gum Tragacanth or Carob Bean Gum. By T. P. Ghose and S. Krishna. *Indian Text. J.*, 1946, **56**, No. 666, 506-508, 561. An account of a preparation made from tamarind seed.

Utilisation of Kiri. An Alternative Source of Lac Resin. By B. S. Gidvani and N. R. Kamath. *Chem. Age*, 1946, **54**, No. 1409, 723-726. Kiri is the residue left in the filter bags in the preparation of shellac by hot filtration in India.

Cashew Nut Shell Liquid as a Raw Material in the Paint and Varnish Industry. The Action of Sulphur on Cashew Nut Shell Liquid and the Production of a Petrol- and Water-resistant Varnish. By S. K. Ranganathan and K. G. Tandon. *Paint Technol.*, 1946, **11**, No. 123, 94-95.

IMPERIAL INSTITUTE

CONSULTATIVE COMMITTEE ON INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

QUARTERLY BIBLIOGRAPHY OF INSECTICIDE MATERIALS OF VEGETABLE ORIGIN, NO. 35

(April to June 1946)

Compiled by MISS R. M. JOHNSON

With the collaboration of the Imperial Institute of Entomology and the Department of Insecticides and Fungicides, Rothamsted Experimental Station.

GENERAL

The Western Grape Leaf Skeletonizer *Harrisina brillians* in California. By W. H. Lange. *Bull. Dep. Agric. Calif.*, 1944, **33**, No. 2, 98-104. (*R.A.E.*, 1946, **34**, A, Pt. 4, 112.) Sprays of rotenone and nicotine and dust of cube effective.

Experiments with Insecticides to Control the Strawberry Weevil in North Carolina and Maryland. By W. A. Thomas. *J. Econ. Ent.*, 1945, **38**, No. 6, 678-682. Derris and pyrethrum were less effective than calcium arsenate and cryolite : nicotine-bentonite was not effective.

Some Common Insecticides and Their Use. Part II. By L. W. Miller. *Tasm. J. Agric.*, 1946, **17**, No. 1, 189-192. Discusses nicotine and rotenone.

The Colloid Chemistry of Insecticides. By O. A. Nelson. *Colloid Chem.*, 1946, **6**, 268-273. (*Amer. Chem. Absts.*, 1946, **40**, No. 8, 2,257.) Nicotine-bentonite and aerosol fogs of pyrethrum extract, and nicotine are discussed.

The Olive Bug. By E. C. G. Pinhey. *Rhod. Agric. J.*, 1946, **43**, No. 1, 8-10. Dusts which have proved effective against *Teleonemia australis* contain pyrethrum or derris, pyrethrum killing the quicker : nicotine spray also effective.

Histological Effects of Sesamin on the Brain and Muscles of the Housefly. By A. Hartzell and E. Wexler. *Contrib. Boyce Thompson Inst.*, 1946, **14**, No. 3, 123-126.

De Gevoeligheid van Zijderupsen voor Derris- en Pyrethrumstuifmengsels. By J. J. Fransen. *Tijdschr. PlZiekt.*, 1943, **49**, No. 4, 126-129. (*R.A.E.*, 1946, **34**, A, Pt. 3, 91.) The susceptibility of silkworms to derris and pyrethrum.

Versuche zur Bekämpfung der Kohlwanze (*Eurydema oleraceum* L.) mit Chemischen Mitteln. By W. Frey. *Arb. Phys. Angew. Ent., Berlin*, 1942, **9**, No. 2, 77-89. (*R.A.E.*, 1946, **34**, A, Pt. 3, 89.) Rotenone, derris, nicotine and quassia were tested against this pest of swedes but were ineffective.

De Bestrijding van de Dennenbladwesp (*Diprion pini* L.) in Nederland. By J. J. Fransen. *Tijdschr. PlZiekt.*, 1942, **48**, No. 6, 217-225. (*R.A.E.*, 1946, **34**, A, Pt. 3, 88-89.) Dusts containing both derris and a small amount of pyrethrum were considered promising in the control of the pine sawfly.

Étude sur les Produits utilisés en France contre le Doryphore. By M. Raucourt and H. Bégue. *Monogr. Sta. Lab. Rêch. Agron., Paris*, 1942. (*R.A.E.*, 1946, **34**, A, Pt. 3, 84-85.) Among the products studied for the control of the Colorado beetle were rotenone and nicotine: rotenone effective.

Factors Influencing the Interaction of Insecticidal Mists and Flying Insects. Part II. The Production and Behaviour of Kerosene Base Insecticidal Spray Mists and their Relation to Flying Insects. By W. A. L. David. *Bull. Ent. Res.*, 1946, **37**, Pt. 1, 1-28.

Combined Insecticide and Germicide. U.S. Pat. No. 2, 358,986. Contains pyrethrum, rotenone or nicotine. *Pharm. Absts.*, 1946, **12**, No. 1, 11, in *J. Amer. Pharm. Assoc., Sci. Ed.*, 1946, **35**, No. 1.

Mixed Insecticide. Canad. Pat. No. 429,521. *Soap*, 1946, **22**, No. 3, 149. Contains an alkyl ester of an unsaturated dicarboxylic acid and an extractive of a plant selected from the group consisting of derris, cube and pyrethrum.

ALKALOID-CONTAINING MATERIALS

Tobacco Products, including Nicotine and Nicotine Derivatives

Rate of Penetration of Nicotine into the Cockroach from Solutions of Various Hydrogen Ion Concentration. By C. H. Richardson. *J. Econ. Ent.*, 1945, **38**, No. 6, 710-711.

Insecticidal Tests of Some Materials on the Mexican Bean Beetle. By E. R. McGovran and P. G. Piquett. *U.S. Dep. Agric., Bur. Entomol.*, E-682. (*Amer. Chem. Absts.*, 1946, **40**, No. 10, 2923.) Among a great number of materials tested results are given of 13 nicotine combinations and one plant material.

Spray Schedules for Pear Orchards especially subject to Pear Psylla and Codling Moth. By W. A. Ross. *Publ.* No. 40, *Div. Entomol., Dep. Agric. Canada*, 1946. Nicotine sulphate included in the spray schedule.

The Onion Thrips (*Thrips tabaci* Lind). By K. A. Rahman and Anshi Lal Batra. *Indian J. Agric. Sci.*, 1945, **14**, Pt. 4, 308-310. Nicotine spray gave good results.

The Control of Warble Flies with Nicotine Sulphate. By I. Thomas and G. Williams. *Welsh J. Agric.*, 1945, **18**, 78-80. (*R.A.E.*, 1946, **34**, B, Pt. 5, 86.)

De Preiinsecten. By W. J. Maan. *Tijdschr. PlZiekt.*, 1943, **49**, No. 4, 132-133. Leek insects controlled by a nicotine spray.

Nicotine Determination in Tobacco and Its Extracts. By P. A. Rowaan. *Chem. Weekblad.*, 1945, **41**, 7-9. (*Amer. Chem. Absts.*, 1946, **40**, No. 5, 1282.) A modification of the Pfyl and Schmitt method.

Ann. Rep. W. Afr. Cacao Res. Inst., 1944-45. Refers to the work carried out with nicotine sulphate sprays and dusts in controlling pests of cacao, p. 23.

Zur Bekämpfung der Kirschenfliege und des Pflaumenwicklers. By F. Schneider. *Schweiz. Z. Obst. Weinb.*, 1945, **54**, 252. (*Hort. Absts.*, 1946, **16**, No. 1, 22.) Cherry fly control by DDT and the red plum maggot by nicotine.

A Mass Investigation and Struggle against Mosquito Hibernation in the Chuisk Valley of the Kirghizssr. By K. G. Naumov. *Trav. Acad. Milit. Méd. Kiroff Armée Rouge*, 1941, **25**, 198-215. (*R.A.E.*, 1946, **34**, B, Pt. 5,

75-76.) Control measures adopted consisted in fumigation of cellars by burning tobacco dust for several hours.

Insecticides. U.S. Pat. No. 2,392,961. *Amer. Chem. Absts.*, 1946; **40**, No. 8, 2261. Synergism indicated between various nicotine compounds and DDT in the control of the melonworm and the southern armyworm.

Nicotine Made in Brazil. *Chem. Tr. J.*, 1946, **118**, No. 3083, 802. First factory started up.

INSECTICIDE MATERIALS CONTAINING ROTENONE AND ALLIED SUBSTANCES

General

Rotenone (Synopsis of Information). By L. N. Markwood and L. G. Arrington. *Industr. Ref. Serv., U.S. Dep. Comm.*, 1945, **3**, Pt. 2, No. 48, 1-6.

Timing Rotenone Applications for Control of the Pea Aphid on Long Island, with special reference to Mosaic Incidence. By H. C. Huckett. *Bull.* No. 715, *N.Y. Agric. Exp. Sta.* Pp. 30, 9 × 6. (Geneva, N.Y.: Agricultural Experiment Station, 1945.)

The Pea Weevil and Methods for Its Control. By T. A. Brindley, J. C. Chamberlin, F. G. Hinman and K. W. Gray. *Frms.' Bull. No.* 1971, *U.S. Dep. Agric.*, 1946. Rotenone dust gives control.

The Effects of Rotenone-bearing Dusts on the Diamond-Back Moth (*Plutella maculipennis* Curt.). By W. Cottier and H. Jacks. *N.Z. J. Sci. Tech.*, 1945, **27**, No. 3, 244-249.

De Gevoeligheid van Nederlandsche Insecten voor Derris. By F. E. Loosjes. *Tijdschr. PlZiekt.*, 1945, **51**, No. 2, 29-39. (*R.A.E.*, 1946, **34**, A, Pt. 4, 97.) An alphabetical list based on Dutch literature and the author's investigations of 200 species of insects showing their susceptibility to dusts and sprays of derris.

Action de la Roténone sur certaines Espèces de Culicidés appartenant aux Genres *Culex*, *Anopheles* et *Aëdes* à leurs differents Stades d'Évolution. By H. Floch and P. de Lajudie. *Publ. No.* 101, *Inst. Pasteur Guyane*, 1945.

El Escarabajo de los Patatales. *Publ. Minist. Agric., Madrid*, 1944. (*R.A.E.*, 1946, **34**, A, Pt. 4, 100.) Rotenone one of the materials for controlling the potato beetle.

Rotenone Insecticide. U.S. Pat. No. 2,369,855. *Soap*, 1946, **22**, No. 4, 155. A concentrated insecticidal paste containing 20 parts of rotenone-bearing root, 20 parts of wood flour, 20 parts of pine oil and 5 parts of the dioctyl ester of sodium sulphosuccinate and 35 parts of petroleum distillate.

Peru to Increase Rotenone Output. *Agric. in Americas*, 1946, **6**, No. 2, 36-37.

Rotenone Situation [in U.S.A.]. *Soap*, 1946, **22**, No. 3, 143.

Peruvian Rotenone Agreement [with U.S.A.]. *Soap*, 1946, **22**, No. 4, 94.

Derris

A Comparison of the Number of Protoxylem Strands with the Rotenone Content of Derris Roots. By D. G. White. *Amer. Soc. Hort. Sci. Proc.*, 1945, **46**, 370-374. (*Exp. Sta. Rec.*, 1946, **94**, No. 3, 357.)

Proefnemingen ter Bestrijding van de Preivlieg in 1939 en 1940. By G. W. van der Helm. *Tijdschr. PlZiekt.*, 1942, **48**, No. 1, 17-26. (*R.A.E.*, 1946, **34**, A, Pt. 3, 67-68.) In experiments on the control of leaf miners on leeks derris powder was found unsatisfactory.

Stuiven en Spuiten met Derris tegen de Vlasthrips. By W. Spoon. *Tijdschr. PlZiekt*, 1940, **46**, No. 5, 157-162. (*R.A.E.*, 1946, **34**, A, Pt. 3, 67.) Good results obtained with derris against the flax thrips.

Literature of the Black Carpenter Ant, *Camponotus herculeanus pennsylvanicus* (de Geer). A Bibliography with Abstracts. By L. H. Townsend. *Circ. No.* 59, *Kentucky Agric. Exp. Sta.*, 1945. (*Amer. Chem. Absts.*, 1946, **40**, No. 10, 2923.) Control by a number of products is considered, among which derris is included.

Biology and Control of the American Dog Tick [*Dermacentor variabilis*]. By C. N. Smith, M. M. Cole and H. K. Gouck. *Tech. Bull. No.* 905, *U.S. Dep. Agric.*, 1946. Derris much more effective than cube-sulphur or pyrethrum.

Malayan Derris Prospects. *Chem. Tr. J.*, 1946, **118**, No. 3079, 680.

Derris in Malaya: Jap Neglect Wrought Damage. *Foreign Comm. Wkly.*, 1946, **22**, No. 13, 36.

Insecticidal Compounds. By J. E. Dudley, Jr., T. E. Bronson and F. H. Harries. *U.S. Dep. Agric., Bur. Entomol.*, E-651. (*Soap*, 1945, **21**, No. 12, 86.) Against pea-aphid. A number of compounds tested. DDT more effective than derris at comparable strengths.

Method of Combating Warble Fly. By W. Stack and W. Hausam. *Collegium*, 1942, 273-287. (*Brit. Absts.*, 1946, March, B III, 59.) Young larvae are killed by repeated washing in the stall with an aq. 2-3 per cent. derris preparation. This is followed by an occasional treatment with an 8-10 per cent. derris wash in the field to kill older larvae. Both treatments are essential.

PYRETHRIN-CONTAINING MATERIALS

Pyrethrin Content Studies. By R. H. Carter, S. B. Soloway, H. D. Mann and N. Green. *Soap*, 1946, **22**, No. 4, 157. Gives particulars of the pyrethrin content of pyrethrum flowers from various countries.

Evaluating Pyrethrum Extract. By W. F. Barthel, W. A. Gersdorff, F. B. LaForge and J. J. T. Graham. *Soap*, 1946, **22**, No. 3, 129, 131. A comparison of chemical and biological methods of evaluating concentrated extracts.

The Alleghany Mound Ant and Its Control. By W. A. Price. *J. Econ. Ent.*, 1945, **38**, No. 6, 706. This ant, *Formica exsectoides*, is controlled by treating its mounds with a commercial pyrethrum solution: the effect is immediate.

The Prophylaxis of Phlebotomus Fever by Means of Sandfly Control in City Conditions. By P. P. Perfil'ev and V. Y. Podolyan. *Trav. Acad. Milit. Méd. Kiroff Armée Rouge*, 1941, **25**, 255-271. (*R.A.E.*, 1946, **34**, B, Pt. 5, 79.) Atomised pyrethrum spray best means of controlling the sandflies in houses.

On the Blood-sucking Diptera in Transbaikal Region (East Siberia). By A. V. Gutzevich. *Trav. Acad. Milit. Méd. Kiroff Armée Rouge*, 1939, **19**, 35-47. (*R.A.E.*, 1946, **36**, B, Pt. 3, 41.) Field tests confirmed the value of pyrethrum smoke-candles in reducing attack by blood-sucking Diptera and showed that candles in which the pyrethrum powder was replaced by tobacco dust were equally effective.

Remedies against Black-flies and Mosquitoes. By I. A. Rubtzog. *Trav. Acad. Milit. Méd. Kiroff Armée Rouge*, 1939, **19**, 61-74. (*R.A.E.*, 1946, **36**, B, Pt. 3, 42.) Sticks made of thyme (*Thymus serpyllum*) were about as effective as pyrethrum candles against these pests: cinnamon oil acted as a repellent but only remained effective for 24 hours.

Principles of Insecticidal Action as a Guide to Drug Reactivity Phase Distribution Relationships. By H. Hurst. *Trans. Faraday Soc.*, 1943, **39**, Pt. 12, 390-411. (*R.A.E.*, 1946, **34**, A, Pt. 3, 85-87.) The effect of pyrethrins discussed.

The Synergistic Action of N.N-Diethylpiperonyl Amide with Pyrethrum Marc in Control of the Mexican Bean Beetle. By C. A. Weigel and S. I. Gertler. *J. Econ. Ent.*, 1945, **38**, No. 6, 683-686.

DDT Against House Flies. By W. A. Gersdorff. *Soap*, 1946, **22**, No. 3, 126-127. Compares the toxicity to houseflies of p-p' DDT, o-p' DDT and pyrethrum extract.

Mixed Insecticide. U.S. Pat. No. 2,377,798. *Soap*, 1946, **22**, No. 3, 127. Consists of pyrethrum, sodium fluosilicate and dextrin: may also contain sulphur or peanut flour.

Insecticide. U.S. Pat. No. 2,367,155. *Pharm. Absts.*, 1946, **12**, No. 3, 95, in *J. Amer. Pharm. Assoc., Sci. Ed.*, 1946, **35**, No. 3. Halo-acyl ester of a terpene alcohol, e.g. fenchyl chloroacetate enhances the toxic effect of pyrethrum extract.

Pyrethrum Parasiticides. Brit. Pat. No. 572,310. *Brit. Absts.*, 1946, Feb., B III, 36.

Increasing the Efficiency of Insect-Destroying Drug Extracts. U.S. Pat. No. 2,376,702. *Pharm. Absts.*, 1946, **12**, No. 3, 95 in *J. Amer. Pharm. Assoc., Sci. Ed.*, 1946, **35**, No. 3. Extraction of pyrethrum flowers by carbon tetrachloride plus formic and phosphoric acids yielded extracts possessing 20 per cent. to 50 per cent. greater insecticidal effectiveness.

Insecticides [dichlorophenoxymethanes]. By C. L. Moyle. U.S. Pat. No. 2,330,234. *Brit. Absts.*, 1946, Feb., B III, 21. Addition of pyrethrins (said to act as synergist) is also claimed. Examples illustrate their use against Mexican bean beetle.

Forest Research in India and Burma, 1943-44. Part I. The Forest Research Institute. Refers to the fact that analyses of pyrethrum grown in Dehra Dun, Pindar Range and Quetta confirm the view that the pyrethrin content of the pyrethrum flowers tends to improve in successive generations of the plant.

Pyrethrum Cultivation in Kumaun (United Provinces). By T. R. Low and J. G. Burns. *Indian Frmg.*, 1946, **7**, No. 2, 63-65.

Portuguese Production of Insecticides. *Foreign Comm. Wkly.*, 1946, **22**, No. 10, 27. Gives figure for pyrethrum.

OTHER INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

Field Trials of Insecticides for the Control of Sugar-cane Froghopper. By A. Pickles. *Trop. Agric., Trin.*, 1946, **23**, No. 1, 9-11. Sabadilla and DDT showed promise.

Sabadilla, an Insecticide to Control the Squash Bug. By M. D. Wallace. *Amer. Soc. Hort. Sci. Proc.*, 1945, **46**, 284. (*Exp. Sta. Rec.*, 1946, **94**, No. 3, 359.)

Sabadilla for the Control of the Green Stinkbug (*Acrosternum hilaris*). By N. W. Frazier. *J. Econ. Ent.*, 1945, **38**, No. 6, 720.

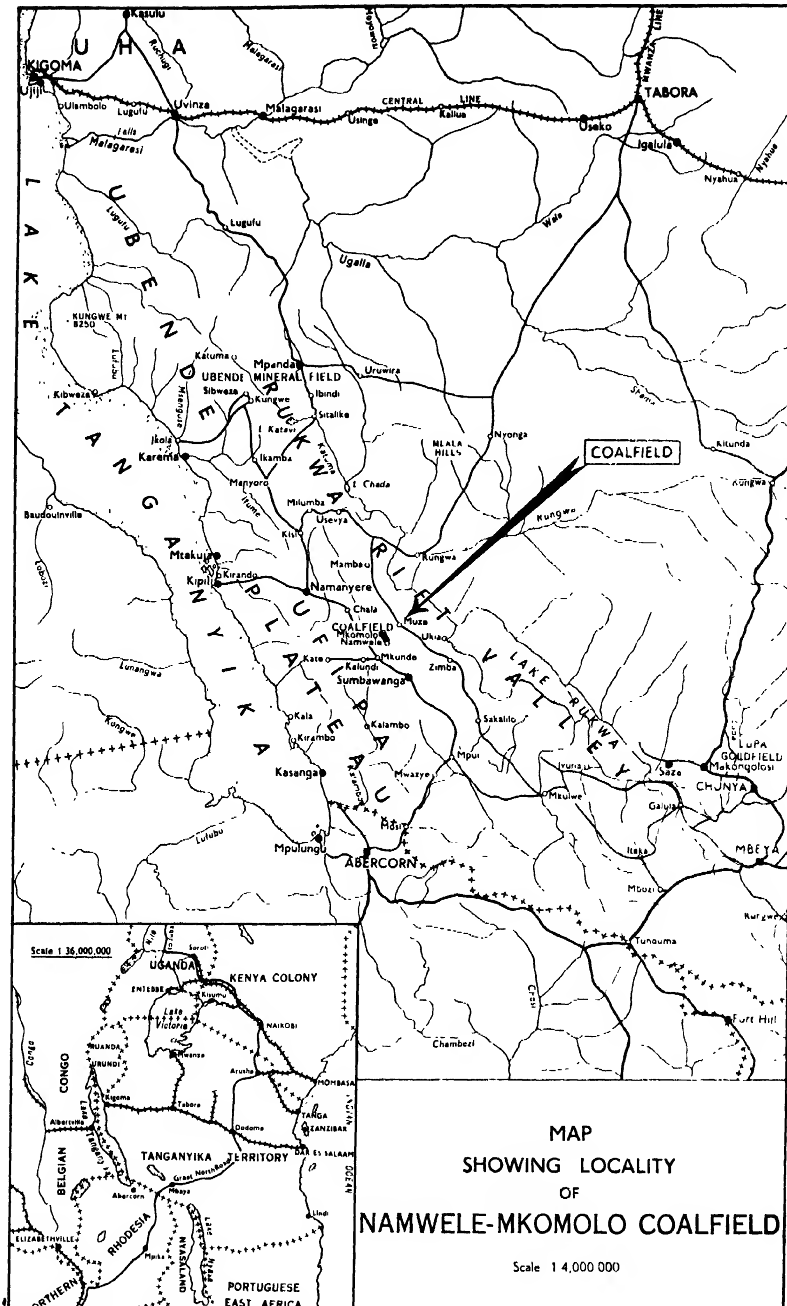
Chinch Bug Dust Barrier: Preliminary Tests. By R. R. Walton. *J. Econ. Ent.*, 1945, **38**, No. 6, 713-714. A 10 per cent. sabadilla dust was the most effective material.

New Insecticides Give Promise for Control of Lygus Bugs in Alfalfa Grown for Seed. By C. H. Sorenson and J. W. Carlson. *Farm and Home Sci.* [*Utah Sta.*], 1945, **6**, No. 3, 5, 11. (*Exp. Sta. Rec.*, 1946, **94**, No. 4, 501.) DDT at the rate of 10 per cent. gave the best control of Lygus and highest average yields of seed, while DDT 3 per cent. and sabadilla 10 per cent. ranked second and third respectively.

New Insecticides. *Food Industr.*, 1946, **18**, No. 5, 194-195. Reference to the use of sabadilla.

A New Plant Insecticide for Control of the European Corn Borer. By B. P. Pepper and L. A. Carruth. *J. Econ. Ent.*, 1945, **38**, No. 6, 59. Prepared from *Ryania speciosa* and known as Ryanex. Very effective.

Insecticide [Prickly Ash]. By F. B. LaForge and H. L. Haller. U.S. Pat. No. 2,328,726. *Brit. Absts.*, 1945, Dec., B III, 246.



Location Plan of Namwele-Mkomolo Coalfield.

facing page 227]

MINERAL RESOURCES

ARTICLES

THE GEOLOGY OF THE NAMWELE-MKOMOLO COALFIELD, UFIPA DISTRICT: WITH NOTES ON UNDERGROUND EXPLORATION CARRIED OUT BY THE TANGANYIKA GOVERNMENT

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Introduction

Tanganyika Territory has large undeveloped coal resources, and in 1942 it was decided to make a detailed examination of the Ufipa coalfields, as these are the most accessible from the existing transport routes. The Ufipa coalfields lie near the south-western border of Tanganyika Territory between Lake Rukwa and the southern end of Lake Tanganyika (*see* Location Plan, Pl. I); they consist of two areas of coal-bearing rocks, the Namwele-Mkomolo Coalfield and the Muze[1] Coalfield. The former is situated on the Ufipa Plateau at an altitude of about 5,700 ft. and the Muze Coalfield is on the floor of the Rukwa Rift Valley at 3,000 ft. above sea level. The coal at both localities occurs in rocks of the Karroo System. Patches of rocks which can be correlated with the coal-bearing Karroo System of South Africa and Southern Rhodesia are found in isolated blocks, faulted into the gneisses of the Basement Complex, along a line stretching from Albertville in the Belgian Congo south-eastwards through the Rukwa Valley to Lake Nyasa. A number of these Karroo blocks contain well-developed coal seams.

At present the nearest communications to Namwele are by steamer on Lake Tanganyika. The small port of Kipili is 88 miles distant by all-weather road, and Mpulungu, a better equipped port in Northern Rhodesia, is 150 miles by good road. Mpanda Mine (Uruwira Minerals, Ltd.) is 150 miles distant by a new road which could easily be rendered all-weather, and is itself connected with Uvinza, on the Central Railway, by 120 miles of all-weather road.

Historical Review

G. M. Stockley, Geologist of this Division, has published (1938)

[1] The spelling *Muse* adhered to in all recent maps is a relic of German occupation; the rendering *Muze* adopted in this paper is correct according to the system of the Royal Geographical Society.

a paper[1] which remains the only authoritative description of the Karroo rocks and coalfields in the south-western part of Tanganyika ; he gives a complete account of the previous geological investigations. Coal was first discovered at Namwele by G. Poultier de Montechor early in 1914, and the field was at once examined by E. Kirschstein for the German Government. Some claims were pegged by G. Poultier under the German ordinance. In 1925, when Tanganyika had come under British mandate, claims were again pegged both in the Namwele and Muze coalfields, some by the East African Engineering and Trading Co., Ltd., and some by G. Poultier. Certain of these claims were acquired in 1944 by the Government of Tanganyika for the purpose of underground exploration.

J. Parkinson and W. J. Hughes examined the coalfields during 1928-29 for Nyasaland Minerals, Ltd. A number of shafts were sunk and three boreholes put down. Stockley (*op. cit.* pp. 23-24) quotes some notes contributed by J. Parkinson in 1931 on the results of the exploration. G. Poultier de Montechor knows the coalfields intimately and has prepared large-scale maps which have been of great service to the officers of this Survey. We are also grateful to A. G. Doyle for information regarding the exploration of the coal seams.

Distribution of Work and Acknowledgments

A preliminary survey of the coalfields was made by D. R. Grantham, Geologist and Acting Chief Inspector of Mines, in November and December, 1942. In the latter month he measured a base and established a rough triangulation net covering the Namwele-Mkomolo Coalfield ; he also made a topographical and geological map of the Mkomolo coal basin on a scale of 1 : 10,000 by plane-table methods. During December, 1942, and January and February, 1943, a geological survey was made by the writer, who also constructed, in January and February, plane-table maps of the topography and geology of the entire coalfield to a scale of 1 : 25,000, and of the Namwele coal basin to a scale of 1 : 10,000.

In January, 1944, a further programme of pitting and underground exploration was begun under the direction of D. R. Grantham as Acting Chief Inspector of Mines, and of V. T. Hockin, his successor ; this work was carried on continuously until the end of 1945, during which period D. R. Grantham measured a survey line 12,000 ft. long with chain, compass and Abney level to which all pits and underground workings have been tied. He also did all the underground survey except that of the First Level, which was done by W. J. Dorrell. Kavirondo Gold Mines, Ltd., undertook a contract for the exploratory work, and their Superintendent, W. J. Hughes, has given valuable advice on methods of exploration and sampling : he has, moreover, compiled shaft sections, and other geological information. W. J. Dorrell, the Company's Engineer-

[1] *See* "List of Works Consulted" on p. 251.

in-Charge, rendered great service by keeping geological records throughout the work. The operations have been controlled by the Department of Lands and Mines; the Mines Division has superintended the mining and the Geological Division has been responsible for the sampling and recording of results.

The present paper attempts to give a summary of the results of the work from a practical point of view; exploration of the potential coalfields in the Karroo rocks of Ufipa is still proceeding and a memoir incorporating the final results will be published.

Most of the geological measurements in the pits and a large proportion of those in the underground workings were made by D. R. Grantham, with the able assistance of W. J. Dorrell and C. F. Kirschstein. Detailed plans of all pit positions and their geological sections at Namwele, and full logs of all pits and shafts are filed with the Geological Division at Dodoma; these were all prepared by D. R. Grantham, to whom the writer wishes to acknowledge a debt for much help during the entire course of the investigations.

The Imperial Institute kindly consented to carry out chemical analyses and beneficiation tests, and the results of these are included as an Appendix to this paper. Other Appendices record the results of tests made by the laboratory of the Geological Division at Dodoma and by the Tanganyika Railways.[1]

The writer's thanks are due to the staff of the Imperial Institute, to the late F. Oates, and to J. H. Harris and A. Caperle for the preparation of the appendices; to the Chief Mechanical Engineer of the Tanganyika Railways for a report on steaming tests; to J. S. Dunbar for preparing the illustrations, and lastly to members of the Geological Division, who have helped with the manuscript.

The writer is very grateful to the Imperial Institute for publishing this paper, and in particular to G. E. Howling and E. H. Beard for much help in preparing it for the press.

Physical Features

The physical and climatic conditions of Ufipa District cover a wide range as the central plateau is bordered to east and west by deep rift valleys. The main feature of the country is the Ufipa Plateau, a wide region of grassland between 5,500 and 6,000 ft. above sea level. Rising above this rolling plain are a number of mountainous areas and inselbergs rising to 7,000 and 8,000 ft. The Ufipa Plateau is a high block, chiefly composed of gneiss, elongated from north-west to south-east: towards the south-west it descends abruptly in a series of great steps to the Tanganyika Rift Valley in which the lake level is 2,534 ft. above sea level. On the north-east it is broken by one of the most impressive fault scarps in East Africa which separates it from the Rukwa Rift

[1] The Appendices will be published in the succeeding number (No. 4) of this Bulletin.

Valley, whose swampy alluvial floor is 2,600 to 2,700 ft. in altitude. To the north-west and south-east the level of the plateau falls and gradually merges into the level of the adjacent flat country.

A chain of highlands marks the north-east rim of the Ufipa Plateau and is deeply dissected by the rejuvenated drainage descending to the Rukwa Valley. The area of Karroo rocks including the Namwele-Mkomolo Coalfield forms a depression 12 miles long and 3 to 4 miles wide lying between the plateau and these marginal highlands; it is drained by a complicated system of valleys all tributary to the Muze River, which itself flows steeply through a gorge to the Rukwa Valley.

Timber and Water

Timber suitable for mining purposes is not found near Namwele but is plentiful on all the scarps and in the hilly areas of the plateau. For the Namwele operations timber was hauled from Mfili, 60 miles distant on the main Kipili road. Plentiful timber is also found on the Manyoro road just north of Kisi.

Small permanent rivers descend from all the highland areas on the Ufipa Plateau, but, owing to the long dry season, water is scarce on the plateau, as no well-digging or drilling operations have been attempted. At Namwele, plentiful water for the limited mining requirements and for domestic use was obtained from a spring fed from the highlands to the north-east.

Geological Formations

The Namwele-Mkomolo Coalfield, as may be seen from the accompanying geological map and from Pl. II, consists of three blocks of Karroo rocks elongated north-west to south-east, and let into the gneisses of the Basement System: the Namwele block lies to the south-east, the Wankulwe and Mkomolo blocks to the north-west. In each block the Karroo rocks overlie the gneiss unconformably and dip to the south-west: thus the boundaries to the north-east are formed by the outcrop of the plane of unconformity and to the south-west by faults. The total length of the coalfield is 12 miles and the width of each block attains 1 to 1½ miles; a system of transverse faults has introduced a wide bar of gneiss which separates the Namwele block from the Wankulwe and Mkomolo blocks.

The basin in which the Karroo sediments were laid down terminated to the south-east, and the lower formations thin out near the present limits of the outcrop in that direction. The Calcareous Series represents a deepening of the basin, and these beds overlapped the Coal Measures on to the gneiss basement.

In the following table the main sub-divisions of the Karroo System made by Hughes and Parkinson and elaborated by Stockley (1938) have been maintained:

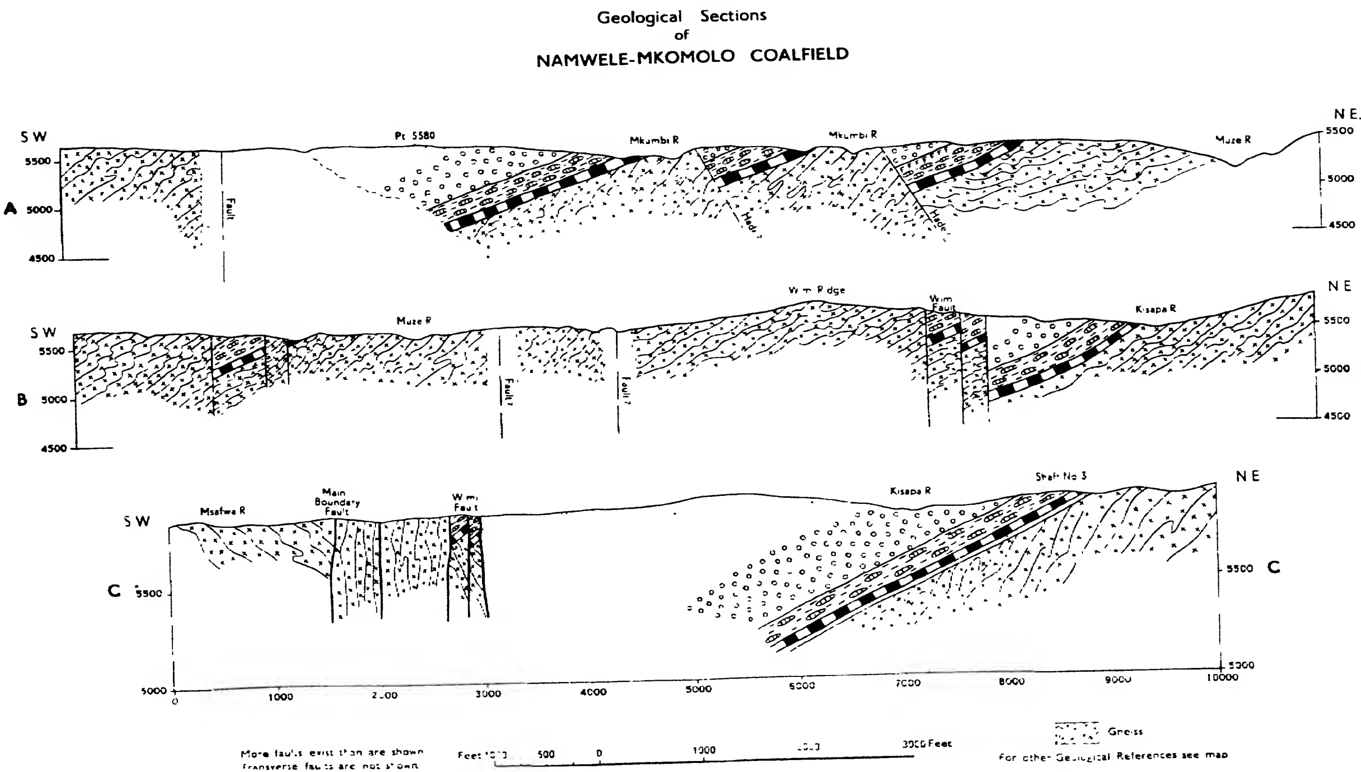
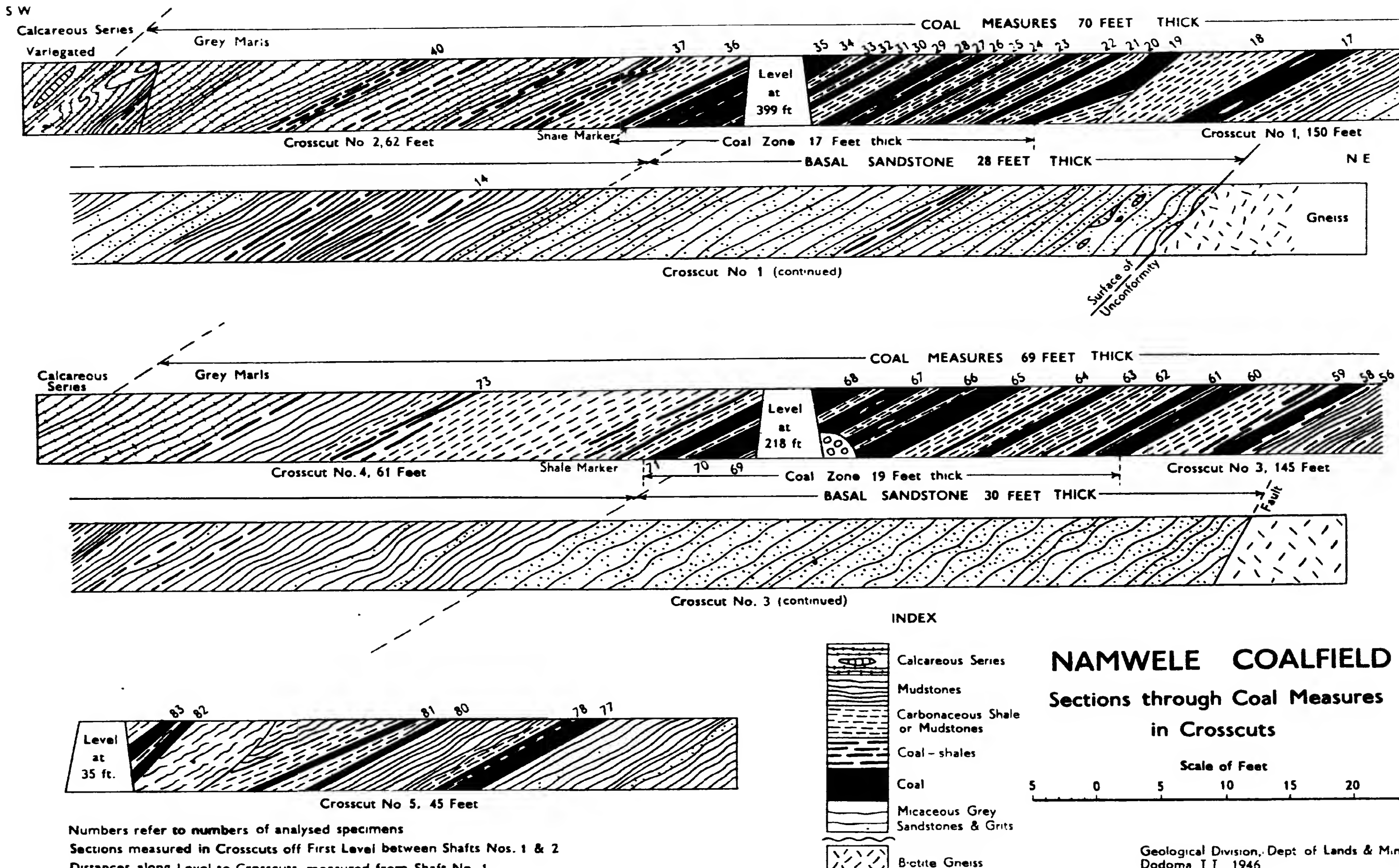


PLATE II.

STRUCTURE OF THE NAMWELE-MKOMOLO COALFIELD.
(Altitudes are in feet above sea level).

facing page 2



NAMWELE COALFIELD

Sections through Coal Measures in Crosscuts

Numbers refer to numbers of analysed specimens
Sections measured in Crosscuts off First Level between Shafts Nos. 1 & 2
Distances along Level to Crosscuts measured from Shaft No 1.

Geological Division, Dept of Lands & Mines, Dodoma, T T, 1946

		Table of Formations	Thickness.
Recent or Late Tertiary		Aggradation Terrace Deposits	
Karroo System	*Upper Sandstones*	Red Sandstones Intermediate Arkoses	over 2,000 ft.
	Calcareous Series	" Flagstone " Series Variegated Marls	200 ft.
	Coal Measures	. . . .	70-100 ft.
	Basal Sandstones	. . . .	30-40 ft.
		Unconformity	
Basement System		Biotite-gneiss	

The rocks of the *Basement System* form a granitic migmatite complex composed mainly of biotite-gneisses banded with pink pegmatite. At a number of points the plane of unconformity at the base of the Karroo rocks can be seen and the underlying gneisses are found to be deeply weathered and kaolinised. This is evidence of a pre-Karroo peneplane which was of great age when finally submerged.

The *Basal Sandstones* consist of hard, grey sandstones and arkoses with scattered pebbles or small boulders. The sandstones become more argillaceous towards the top of the formation and then contain plant remains. At Namwele these sandstones include many scattered boulders near the base, but never show a true basal breccia ; the pre-Karroo land surface was thus very flat and the invasion by the Karroo waters was quiet and gradual. Good exposures of the base of the Karroo may be seen in the Tambalala River, Mkomolo, and in crosscut No. 1 of the First Level, shaft No. 1, at Namwele : it is difficult to distinguish between gneiss and sandstone because the invading waters have merely re-sorted the sands, resulting from the weathering of the pre-Karroo land surface.

Intercalations of coal and coal-shale are found in the Basal Sandstones : at Wankulwe, chocolate shales and mauve argillaceous sandstones and mudstones occur. The Basal Sandstones are much reduced at Mkomolo, and also thin out towards the south-eastern end of the Namwele block.

The *Coal Measures* are known for a strike distance of 6½ miles from Mkomolo to Namwele ; over most of this distance their thickness varies between 50 and 100 ft. Towards the south-eastern end of the Namwele block the Coal Measures thin out, lose their coal and the Calcareous Series rest almost directly on the gneiss basement. The rocks composing the Coal Measures are mainly compact grey mudstones, micaceous and carbonaceous. With increase of plant remains the mudstones become darker and pass to carbonaceous shales. Grey and dark-grey sandstones, more or less argillaceous, with scattered grains of quartz, are common ; they contain plant remains and carbonaceous matter. The seams of coal are numerous and often contain much ash ; all gradations between coal and carbonaceous shale can be found. The Coal Measures contain a well-marked " Coal Zone," which has been investigated particularly in the Namwele sinkings.

At the summit of the Coal Measures in the Namwele basin are intercalated beds of grey, buff-weathering coarsely micaceous sandstones. These beds are particularly well developed to the south-east of shaft No. 4, where the Coal Measures start to thin out.

The *Calcareous Series* consists principally of variegated marls, grey, green, terra-cotta and purple in colour with marked spheroidal weathering ; the marls may become sandy and pass to an argillaceous sandstone. Interbedded in the marls are thin beds and nodules of magnesian limestone, weathering grey or buff with a compact yellowish fracture ; it is often brecciated and recrystallised and contains cherty nodules. The bands of limestone may attain 3 ft. in thickness, but are usually broken up into rows of nodules ; the amount of limestone in the marls is very variable. Analyses of typical limestones are given in an appendix to this paper.

In the Mkomolo area, the top of the Calcareous Series is formed by a well-bedded series of hard, fine-grained, platy sandstones and mudstones, grey or buff in colour and resembling flagstones ; these rocks form small cliffs. To the south of the Mtanda River in the Namwele basin the Coal Measures thin out and the Calcareous Series reposes directly on the gneiss, its base being formed by reddish, argillaceous sandstones.

The *Upper Sandstones* are a heterogeneous series of soft, yellow and brick-red sandstones appearing well-bedded when fresh. They contain clay-shales and marls which display spheroidal weathering. Towards the base are found drab, green and terra-cotta marls with smallish calcareous nodules similar to those lower in the succession. The sandstones are all fine-grained and no coarser elements have been observed. At the base of the Upper Sandstones, over a thickness of 500 to 700 ft., occur the characteristic *Intermediate Arkoses* : these are massive beds (10 to 20 ft. thick) of crumbly, yellow, current-bedded sandstones and grits with irregular layers of polished, unsorted pebbles, from the size of shot up to that of marbles, consisting largely of single crystals of felspar. This formation contains interbeds of marls like those of the Calcareous Series. The total thickness of the Upper Sandstones certainly exceeds 2,000 ft.

Extent of Coal Deposition

It has been shown that the Coal Measures are not present over the whole of the Namwele Karroo block ; towards the south-east the Calcareous Series overlaps on to the gneiss, and the Coal Measures thin out and disappear. It is therefore necessary to discuss the probable extent of the basin of coal deposition. Reasons are given in a later section for believing that the vegetable matter forming the coal was deposited in a swampy lake basin, and, owing to the uniformity of the Coal Measure deposits in the Wankulwe and Mkomolo fault blocks to the north-west, this lake must have covered a large area. Coal was not formed over the whole area

but only in certain basins, and the dismemberment of the Karroo rocks by faulting is such that the extent of coal deposition can no longer be accurately reconstructed. It must be supposed that it is only in the deeper portions of the lake or swamp that the vegetable material deposited would be sufficiently free from silt to form coal; and, owing to the general parallelism of the stratigraphical zones with the structural trends, these deeper basins were probably elongated north-west to south-east.

There appear to have been two principal basins of coal deposition: (1) the Namwele basin to the south-east, comprising the northern portion of the present Namwele fault block, the Mweranganda block and the southern tip of the Wankulwe block; and (2) the Mkomolo basin represented in the central portion of the Mkomolo block with an outlier forming the Mkumbi River coal occurrence.

At Mweranganda there is some 6 ft. of coal in four seams, and as this occurrence is situated to the west of the Namwele outcrops it may be taken to represent a portion of the Namwele basin brought up to the surface by faulting. The presence of coal at Mweranganda may therefore be considered an indication that the Namwele coal seams extend down the dip to the west.

The coal at Wankulwe is lenticular and may form the north-western extremity of the Namwele coal basin.

Structure

The Karroo rocks of the Namwele-Mkomolo Coalfield form a long narrow outcrop extending, with breaks, for 12 miles in a direction 145° true: the width of each outcrop never exceeds 1½ miles. The coalfield is divided into five distinct blocks of Karroo sediments surrounded by gneisses of the Basement Complex; to the south-east the largest block constitutes the Namwele coal basin; to the north-west, beyond a wide bar of gneiss, lie the Mkomolo and Wankulwe blocks; on this bar itself are two much smaller blocks, those of Wimi and Mweranganda. Each of these blocks dips to the south-west and is bounded by a fault in that direction: the opposite boundary, to the north-east, is formed by the outcrop of the basal beds lying unconformably on the gneiss basement. Thus a traverse of each block from north-east to south-west would show the following succession of beds: (1) Basal Sandstones lying unconformably on the gneiss, (2) Coal Measures with local outcrops of coal, (3) Calcareous Series, and (4) Upper Sandstones separated by a fault from the gneiss beyond. Owing to their general structure, these Karroo blocks may be termed *trap-door tilt blocks*, but it is not to be assumed that the tilting is due to faulting along a hinge line. The general strike of the Karroo formations is 145° and the dip is usually from 25° to 30° to the south-west.

Major Faults

The south-western boundary of the coalfield is formed by the *Main Boundary fault* which runs in an average direction of 140°; this is one of the major faults of the area, and can be traced over a distance of at least 60 miles. Reasons are given below (*see* p. 238) for believing that the hade of this fault is vertical. The relationship at Namwele indicates a vertical throw of at least 3,000 ft., but the fault may have a considerable horizontal component.

Other major faults with a general north-westerly direction limit the Mkomolo, the Mweranganda and the Wimi blocks. The Wankulwe block is limited by a fault with a northerly trend, and two similar faults have introduced a wide gneiss bar forming Wimi hill which divides the coalfield into two sections. There is evidence to show that all these faults are vertical. In the Mkomolo block, between the Tambalala and Mkumbi rivers a wedge of gneiss has been faulted in, thus causing a duplication of the Coal Measures.

Parallel to each of the major faults in the map area run one or more *satellite faults* which bring up packets of the lower strata and pinch them between the Upper Sandstones and the gneiss wall of the fault. These faults are caused by the drag between the two walls of the main fault; they are well seen to the south-east of Wimi hill (*see* p. 238).

Minor Faults

The borders of the blocks of Karroo between the major faults are very regular in outline, and minor faults, not distinguishable except by careful pitting, must be very few. At one point in the Namwele coal basin the seams are displaced about 100 ft. in the horizontal plane (*see* p. 238). At Wankulwe one fault has a similar displacement of 50 ft. Some minor faults are suspected in the coal outcrops at Mkomolo. Many slips and very small faults with a throw of a few feet were found during the underground work at Namwele; none of these are sufficiently important to affect the plan of the workings.

Age of Faulting

All the faults affecting the Karroo rocks in the Namwele-Mkomolo Coalfield are planed by an erosion surface in continuity with the main Ufipa Plateau peneplane. This peneplane is provisionally correlated with the principal peneplane widely represented in East and Central Africa which is dated by most authors as Miocene.

The writer[1] has described observations which show that the Main Boundary fault originated in pre-Cambrian times, was rejuvenated at some period between the Jurassic and the Miocene, and moved again in recent times, causing a small scarp, which has

[1] Ann. Rep. Geol. Surv. Tanganyika, 1943 (Unpublished).

been followed over a distance of 40 miles. The great dislocation of the Karroo strata which has resulted in the present division into separate blocks took place, therefore, in late Mesozoic or early Tertiary times.

The Namwele Coal Basin

The Namwele coal basin proper is in the largest of the blocks of Karroo rocks which form the Namwele-Mkomolo Coalfield, and is the farthest to the south-east. The surface of the block is oval in shape ; it is 18,000 ft. in length and 7,000 ft. in greatest width ; the topography is subdued and is mainly controlled by the soft sandstones of the Upper Karroo. It is on this basin that most of the recent work in Ufipa has been concentrated.

Exploration Work

Pitting and trenching to determine the extent of the surface outcrop of the coal seams was started in January, 1943, and continued until a complete picture was obtained ; the total depth of the pits amounted to 3,230 ft. over a length of strike of 14,600 ft. The thinning out of the Coal Measures to the south-east, described below, was shown by this pitting.

Underground exploration work has consisted of shaft sinking, driving of headings, crosscuts, etc., in all a total of 3,310 ft. of development work. Four shafts were sunk as follows :

Shaft No. 2, the furthest to the N.W.	.	166 ft. deep
„ „ 1, 582 ft. S.E. from Shaft No.	2	177 „
„ „ 3, 1,695 „ „ „ „	1	139 „
„ „ 4, 2,308 „ „ „ „	3	75 „

Shafts Nos. 1 and 2 are towards the north-western end of the coal outcrop, No. 3 is in the centre and No. 4 near the south-eastern end. The First Level drive (*see* Pl. VI), 585 ft. in length, was started at 168 ft. in shaft No. 1 and connects shafts Nos. 1 and 2 following the best coal ; sections of the face were measured every five feet by W. J. Dorrell, and the resulting pictures are shown in Pl. V. The Coal Measures were traversed completely by two crosscuts and partially by a third ; sections measured in them are shown in Pl. III.

From the First Level station shaft No. 1 was continued on the dip as an inclined shaft, following the best coal for 476 ft. of inclined length, and reached a point on the coal seams 350 ft. vertically below the ground surface. Headings for exploration and sampling were made at intervals of 100 ft. and inclined crosscuts through the Coal Zone made from each of these. From the lowest of these sub-levels (450 ft. inclined depth) the Coal Measures were completely crosscut. These workings are shown in Pl. VI and sections are given in Pl. IV.

A similar incline shown in Pl. VI, with extension upwards to

surface, was sunk from the bottom of shaft No. 4 and extended to 505 ft. of inclined length reaching a point 211 ft. vertically below ground level. Similar headings and crosscuts were made at every 100 ft. and a crosscut through the Coal Measures from the bottom sub-level was nearly completed; sections are given in Pl. IV.

Sampling

(i) During the driving of the First Level, samples of individual seams were taken and analysed in the Geological Division Laboratory at Dodoma.

(ii) Six channel samples of the main coal seams were taken and dispatched to the Imperial Institute, London. Four of these were taken from No. 1 and two from No. 4 shafts. In addition, channel samples of the strata below the best coal were sent to the Imperial Institute.

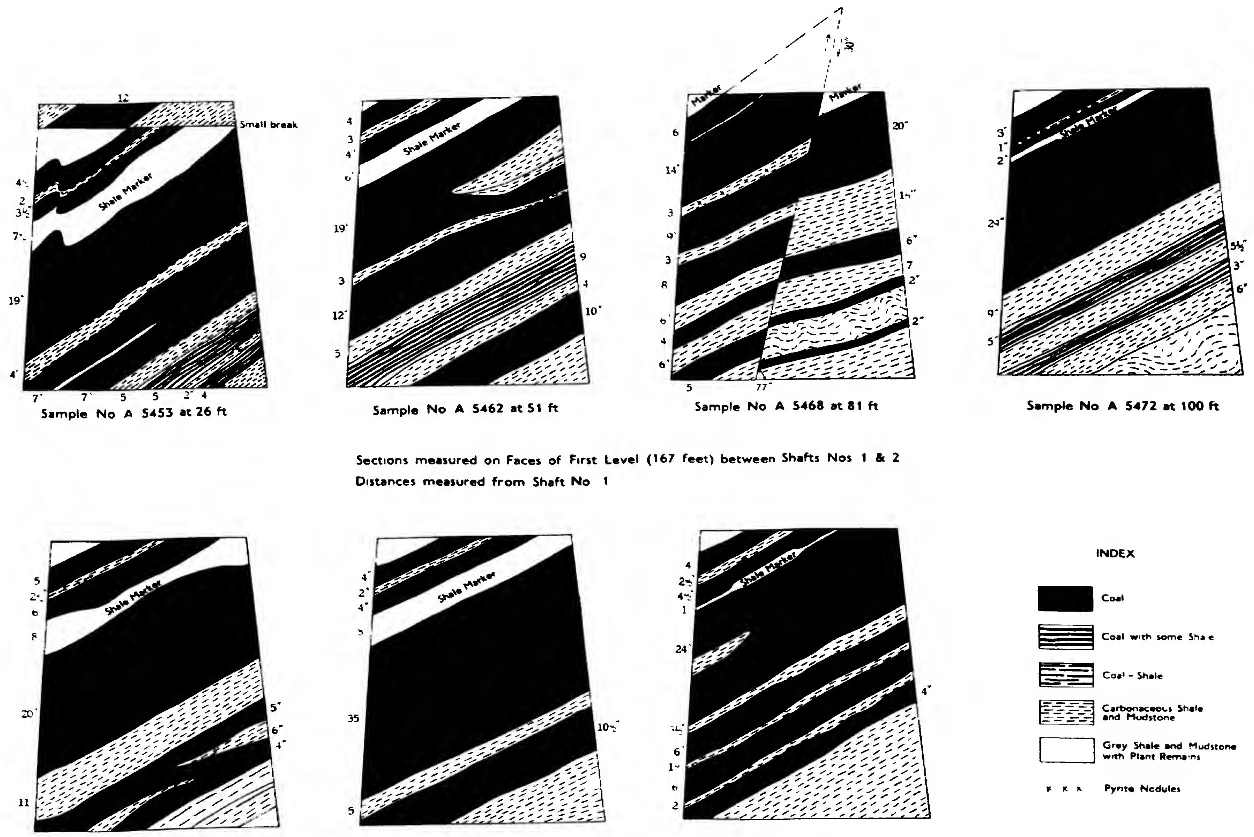
(iii) Six bulk samples of coal and coal-shales were taken and stored in sealed drums for identical examination; one was tested in the laboratory of the Geological Division at Dodoma. (*See* Appendix.)

(iv) Four samples for steaming tests on the Tanganyika Railways were taken from the No. 1 shaft workings as follows: No. 1 consisted of 20 tons of handpicked coal collected during the advance of the First Level; No. 2 of 14 tons was taken from a specially prepared coal face in the 200 ft. sub-level, 25 ft. from No. 1 inclined shaft, and consisted of about 50 per cent. of the total spoil; No. 3 of 14 tons of handpicked coal from No. 1 shaft between 300 and 380 ft. of inclined depth, and finally No. 4 of 50 tons was a composite sample taken from coal faces at the following points: 4B from 200 ft. sub-level at 25 and 120 ft. from No. 1 shaft, 4C from a small heading off the 300 ft. sub-level, and 4D from a heading off the 455 ft. sub-level 15 ft. from No. 1 shaft.

Geological Formations

The *Basal Sandstones* are an important horizon-marker at Namwele and the long north-eastern margin of the coal basin is formed by the outcrop of the basal unconformity of the Karroo. The surface of unconformity can be seen in crosscut No. 1, off the First Level, shaft No. 1 (*see* Pl. III). The underlying gneiss has been penetrated for some 30 ft. in this crosscut and is found to be deeply decomposed and kaolinised; for the first 10 ft. below the plane of unconformity it is very rotted and soft, in sharp contrast to the overlying rocks of the Karroo. These start with 3 ft. of a coarse poorly stratified arkose containing angular fragments of quartz and felspar, the top of this formation is irregular and slightly eroded. Above come hard grey gritty sandstones with pebbles and some small boulders of biotite-gneiss. The rest of the formation consists of gritty grey, micaceous sandstones with some plant remains, and some beds of grey mudstones.

PLATE V.



Sample No A 5453 at 26 ft

Sample No A 5462 at 51 ft

Sample No A 5468 at 81 ft

Sample No A 5472 at 100 ft

Sections measured on Faces of First Level (167 feet) between Shafts Nos 1 & 2
Distances measured from Shaft No 1

[facing

In shaft No. 3, the most central to the coal basin, coal and coal-shales are found in the Basal Sandstones, and in a natural exposure nearby coal-shales lie almost on gneiss.

It is of great importance to note the absence of conglomerates at the base of the Karroo, and also the deep zone of decomposition of the gneiss basement. This relationship has an important economic bearing, for since the best coal seams are not more than 100 ft. from the gneiss floor, any irregularity in this floor might form an island in the Coal Measures and cause them to be cut out; but the absence of conglomerate throughout the Namwele Coalfield is so marked that the land surface must have been quite flat over large areas, and it is unlikely that there were islands of gneiss.

The *Coal Measures* lie between the Basal Sandstones and the Calcareous Series; their thickness is 70 ft. at No. 1 shaft, about 70 ft. at No. 3 shaft and at least 66 ft. at No. 4 shaft. To the south-east they thin out and disappear about 5,000 ft. beyond No. 4 shaft. Seams of coal-shales and shaly coals grading into each other and the carbonaceous shales are encountered throughout the formation, but the best quality coals are concentrated in a *Coal Zone* some 17 to 19 ft. thick of which a full description is given in a succeeding section. The base of the Coal Measures is never clearly marked but is taken as the point where carbonaceous rocks become dominant. Towards the top of the series the mudstones become more calcareous and pass to grey micaceous rather sandy marls; the upper limit of the carbonaceous material appears to be fairly sharp and is marked by a change of colour from drab grey to the variegated colours of the calcareous series. In the No. 1 shaft crosscuts there are some beds of buff-coloured, coarsely micaceous gritty sandstones near the top of the Coal Measures; these beds form a distinctive horizon at this level in the No. 4 shaft area and further to the south-east (*see* p. 232).

The *Calcareous Series* is 125 ft. thick at Namwele, and its constitution is normal, but the "flagstone" formation which occurs elsewhere at the summit is absent. Analyses of the limestones contained in the series are given in an Appendix; the variable composition militates against their suitability for any large-scale production of cement. It has been reckoned that the beds, lenses and nodules of limestone constitute only about 10 per cent. of the whole series, and therefore unless the marls can be made use of in addition to the limestones the expense of quarrying would be high owing to the excessive waste.

The thickness of the *Upper Sandstones* in the Namwele block is at least 2,000 ft.; the top of the series is not known.

Structure

The structure of the Namwele coal basin is that of a trap-door tilt block and shows in section as a wedge-shaped block of strata dipping 25° to 30° to the south-west; the thin edge of the wedge

lies to the north-east where the basal unconformity outcrops, the thick end leans against the Main Boundary fault and the Wimi fault. The outcrop of the basal unconformity makes a continuous curve forming the north-east, east and south-east boundary of the Karroo rocks; the shape of the curve to the south-east suggests that it is related to the end of the Karroo lake in that direction, and in fact, a stratigraphical overlap exists (*see* p. 231). To the north-west and south-east this boundary is cut off by the faults which limit the Karroo block to the west. In the main central portion of the basin the rocks strike 145° for 10,000 ft. and dip 25° to 30° to the south-west; to the north for 3,000 ft. the strike curves to the west-north-west until it meets the Wimi fault, and to the south of the central segment the strike bends to the south-west until it is cut off by the Main Boundary fault after a further 3,000 ft.

The Main Boundary fault forms the south-western limit of the Namwele block for 10,000 ft.; this fault brings the Upper Sandstones against the gneiss and causes a vertical displacement of at least 3,000 ft. In the southern portion of the map-area a lens of flinty crush breccia has been observed; this is normally a very fine-grained, compact siliceous rock, pinkish in colour and consists of finely ground quartz cemented by silica or a crypto-crystalline groundmass; it often contains larger fragments of quartz.

The "breccia" is really a coarse mylonite; it is in the form of a lens elongated parallel to the fault and dipping vertically. The attitude of this breccia and the fact that many outcrops observed near the course of the fault are also vertical are taken as evidence that the fault itself is vertical. This view is in accordance with other evidence accumulated by the writer that some at least of the major faults of the neighbouring rift valley system are vertical. The average strike of the Main Boundary fault is 140° true.

The Wimi fault forms the western boundary of the Namwele block for 9,000 ft. This fault trends 165° and there is also evidence that it is vertical. On the eastern slopes of Wimi hill the satellite faults mentioned above (*see* p. 234) can be well seen. Packets of Coal Measures, limestone bands, variegated marls and arkoses have been brought up by the satellite faults to form a band from 400 to 1,000 ft. thick on the downthrow side of the fault. The Wimi fault must be older than the Main Boundary fault as it is cut off by the latter.

The age and history of these faults has been referred to on page 234 above.

The Namwele coal basin appears to be fairly free from secondary faults. Pitting has shown that one series of step faults of unknown hade and throw displaces the coal about 100 ft. in the horizontal plane. These faults are situated 1,500 ft. north-west of shaft No. 4. Small faults with throws of a few feet have been seen both on the surface and in underground workings. The many small slips and fractures affecting the Coal Zone will be described below.

The Coal Zone

The Coal Zone at Namwele is 17 to 19 ft. in thickness, and W. J. Hughes has shown that its top is always about 30 ft. below the well-marked horizon formed by the base of the variegated marls of the Calcareous Series; the base of the Coal Zone is therefore about 70 ft. above the gneiss basement.

The zone includes from 7 to 8 ft. of coal in seams ranging in thickness from a few inches up to 3 ft. In between the coal seams are many beds and partings covering all the stages from dark-grey mudstone with plant remains to carbonaceous shales, coal-shales and shaly coal. The seams vary considerably in width and tend to be impersistent, but as they die out other seams make, so that the total content of coal remains about the same. The roof of the Coal Zone is a light-grey mudstone usually containing two small seams of coal; this " marker " was easily recognised throughout the workings. Immediately below the shale marker the best and most persistent seams of coal, called the Main Coal, are concentrated and therefore the marker served as a useful guide during development, being held in the roof of the headings and inclines throughout.

Many of the distinctive characters of the Coal Zone are shown in Pls. V and VII. The sections figured are all measured in the Main Coal at the top of the Coal Zone, and therefore represent the best seams. The following features are well shown by the drawings:

(i) The constancy of the " shale marker " with its two small seams of coal separated by a shale parting. This feature points to regularity in the conditions of sedimentation in the latter part of the period of coal deposition.

(ii) The relative thicknesses of the coal seams and the shale interbeds. Some of what is shown as coal may have a high ash content and thus approach a shaly coal.

(iii) The variation in number and thickness of the coal seams.

(iv) The formation of lenses of shale in the centre of a coal seam.

(v) The breaks and plications which affect the coal seams. These are usually of two sorts: (*a*) horizontal breaks carrying the upper portion of the seams to the south-west over the lower portion, and (*b*) faults roughly parallel to the strike in which the throw may be in any direction, but usually tends to shorten the strata. The movement in both these cases rarely exceeds a few feet.

The sections in Pl. VII show the behaviour of the Main Coal as it was followed down the dip in inclined shafts Nos. 1 and 4. These sections have been compiled from carefully measured sections and drawings made every five feet. The chief characters visible in the First Level drive are all represented. In addition, in No. 1 shaft, marked undulations in the dip are encountered at intervals of about 100 ft.; on the crest of each of these undulations coal seams are broken and fractured in places and the coal itself is

shattered and produces a higher proportion of fines on mining. Between 330 ft. on the incline and the bottom of the shaft the shattering is most pronounced with intervals of 15 to 30 ft. in which the coal is quite solid. The proportion of good-sized lump coal to be obtained from the shattered seams would be low and this fact must be taken into consideration when exploitation is being planned. There is much slickensiding in the crushed zones, and evidence of compression in the form of overfolding and small reversed fractures ; it appears that the shale roof has had a tendency to move down the dip, crushing the coal beneath it. Strike faults of slight throw are common, they hade at all angles and may be either normal or reversed. The conclusion is that regional tectonic movements have taken place when the load of superposed strata over the coal was insufficient to prevent many minor readjustments in the Coal Zone which represents the most " incompetent " layer in the Namwele Karroo block.

In No. 4 inclined shaft the dip is much more constant, but the shale roof has moved considerably down the dip causing a slickensided and crushed layer at the top of the coal ; all the coal seams in this shaft are more or less shattered, and the coal when mined produces only small and medium lump with a high proportion of fines.

The distribution of *pyrite* in the Coal Zone, as seen in No. 1 shaft, appears to be fairly constant throughout the mine. According to the results of chemical analysis about half the sulphur in the coal is contained in pyrite or its decomposition product, gypsum. The pyrite is present either as (*a*) small cubes scattered throughout the coal, (*b*) nodules and pyritised fragments of vegetation, and (*c*) fine veining following the lines of fracture and cleat in the coal. The proportion of pyrite to gypsum increases with depth and hence the tendency to clinker is greater in coals from the deeper levels. In No. 4 shaft, small pyrite nodules are very frequent in all the coal seams.

The *cleat* of the coal is mainly obscured by later fractures, but two systems directed 125° and 5° may represent the cleat.

Estimation of Reserves

Only a provisional estimate of the reserves of coal available in the Namwele coal basin can be made in the absence of deep drill-holes, since exploration has been confined to surface pitting and short sinkings from the outcrop.

The *strike length* of the coal seams is taken as 10,000 ft. in estimating the reserves. Coal seams can be followed for a distance of 12,000 ft. along the outcrop, but for 1,000 ft. at the north-west end of the basin the expected footage down the dip would be too short to warrant mining, and for 1,000 ft. at the south-east end the seams are too thin to be of value.

The *breadth of the coal deposit* at Namwele when measured to

the south-west down the dip is dependent on two factors: (i) the point of intersection of the coal seams by the Main Boundary and Wimi faults and (ii) the extent of the basin of coal deposition. Provisional answers to both these questions were given by the geological examination of the map area, but must be checked by deep drilling when exploitation of the coal is contemplated. Assuming an average dip of 25° to the south-west, and allowing for a zone of shattering 1,200 ft. wide parallel to the boundary faults and their satellites, the breadth down the dip of the coal seams would be about 6,500 ft. in the south-east and would diminish gradually to the north-west: the greatest vertical depth would be just over 3,000 ft. It is argued on page 233 above that because relatively thick coal seams occur at Mweranganda and Wankulwe it may be safely assumed that the coal in the Namwele basin will not diminish in thickness to the west and south-west.

The *total area* underlain by exploitable coal seams is therefore taken as that shown on the map and amounts to roughly 1,000 acres. Assuming an average dip of 25°, the area of the coal seams becomes 1,100 acres.

The *average thickness* of exploitable coal seams has been established from the measurements made during the underground exploration. The best seams of coal are always localised at the top of the Coal Zone and are known as the Main Coal (*see* p. 239), which, with its included shale partings, is from five to six feet thick. The following table gives the average composition of the Main Coal and the height of the working face which would be required. The averages in the four columns are computed as follows: "A" (after W. J. Hughes) from 112 sections in the First Level; "B" from 94 sections in No. 1 inclined shaft; "C" from 67 sections in No. 4 inclined shaft; but "D" is based on the single section in No. 3 shaft combined with measurements in numerous pits on the outcrop of the coal in the same sector.

	A	*B*	*C*	*D*	
Thickness of coal	39	41	39	60	*inches*
Thickness of shale partings	10	25	23	11	,,
Add for undercut	11	11	11	11	,,
Total mining width	60	77	73	82	,,

Each of the measurements being weighted equally, the average thickness of coal is taken as 45 inches.

The following estimates of the tonnages of coal available at Namwele are based on the figures just given and must be regarded as *Indicated Reserves*; they are given in two categories, (*a*) Total Indicated Reserves, and (*b*) Indicated Reserves to a Vertical Depth of 2,000 ft. (this depth is taken as the limit of profitable mining). The tonnages are calculated on the basis of 100 tons per inch of thickness per acre and are as follows:

(a)	Total area underlain by coal	1,000 *acres*
	Total area of coal seams assuming average dip of 25°	1,100 "
	Tonnage of coal	4,950,000 *tons*

Total Indicated Reserves are say 5,000,000 *tons.*

(b)	Area of coal seams to vertical depth of 2,000 ft., assuming dip of 25°	930 *acres*
	Tonnage of coal	4,185,000 *tons*

Indicated Reserves to 2,000 *ft. vertical depth are say* 4,000,000 *tons.*

The Wimi Gneiss Bar

Between the Karroo blocks of Namwele to the south, and Mkomolo and Wankulwe to the north, is interposed a bar of gneiss about a mile in width; in it are situated the hills Wimi, Mweranganda and "Gneiss Ridge," which served as minor trigonometrical points during the topographical mapping. The presence of this bar is due to transverse faults with a direction more or less north-south; the Wimi fault mentioned above is one of these. The Main Boundary fault appears to cross the transverse faults with little deviation, but in the absence of horizon markers it is difficult to trace faults accurately where they are entirely in the gneiss. Two small blocks of Karroo are faulted into the gneiss of the Wimi bar; they are known as the Mweranganda block, and the Wimi block.

The Mweranganda Karroo Block

About three-quarters of a mile east of the summit of Mweranganda, outcrops of Karroo are found in the gully of a tributary to the Muze River. The surface of the ground is deeply covered with deposits of clays, sands and gravels and the rocks are only visible in the deeper gullies; for this reason the outlines of the Karroo block cannot be very accurately traced. The block is probably more or less rectangular in shape, 1,500 ft. long, and 700 ft. wide; it is elongated north-west to south-east parallel to the regional strike of the Karroo.

The Mweranganda block is wedge-shaped in cross-section, like that of Namwele, and dips 30° to the south-west; its north-east boundary is marked by the outcrop of the Coal Measures; it is possible that a small fault has cut out the Basal Sandstones. The remaining three sides of the block are faulted. The Calcareous Series forms the south-western portion of the rectangle and contains much argillaceous limestone, some of which promises well as a natural cement rock but only occurs in small quantities. The Upper Sandstone is missing altogether having been cut off by the south-western boundary fault. A wedge of gneiss has been faulted up between the Coal Measures and the Calcareous Series.

The Coal Measures are badly broken owing to the proximity of the faults, but one measured section of 8½ ft. contained 6 ft. of coal. This shows that coal-forming conditions extended to the west, and hence that it is likely that the Namwele coal seams will continue

westwards down the dip. It is also of interest to find 4 in. of fireclay below the lowest seam; this may represent a "seat earth" and indicate that the seam was formed, at least in part, by vegetation growing on the spot. The outcrop is however much rotted and disturbed and no definite conclusions can be drawn. The coal at Mweranganda is of no commercial importance owing to the very small quantities present. For purely local building requirements, however, the proximity of small quantities of coal and good cement rock might be of value in the future.

Wimi Karroo Block

Carbonaceous shales outcrop in the bed of the Kisapa River half a mile to the north of Wimi hill, and abundant limestone debris fills a small tributary gully entering from the west. These outcrops belong to a small Karroo block similar to that of Mweranganda which has just been described. The limits of the Wimi block cannot be accurately determined owing to the overburden, but the area covered probably does not much exceed 20 acres. The Karroo strata dip 20° to 30° to the south-west, and since the Coal Measures are present, the north-east boundary is most probably formed by the unconformity at the base of the sediments; the remaining three boundaries are faulted, but only the fault on the south-east side can be discovered beneath the overburden.

The only formations visible in this Karroo block are the Coal Measures and the Calcareous Series. Carbonaceous shales are present in the Coal Measures and outcrop in several places, but no coal seams were found. The Calcareous Series contains a higher proportion than usual of limestone in thin beds and lenses; the limestone has been brecciated and re-cemented, which gives it a crystalline aspect on the fractured surface; it contains flints.

The Wankulwe Karroo Block

The Wankulwe block of Karroo rocks lies to the north-west of the Wimi gneiss bar; it is oblong in shape and elongated to the north-north-west; its length is 13,000 ft. and the greatest breadth is 4,500 ft. Two rivers, the Wankulwe and Mkumbi, traverse the block; between them is the rounded sandstone hill, Chivunja, 5,800 ft. high.

Geological Formations

The Karroo formations in the Wankulwe block are similar to those at Namwele. Outcrops are very scanty throughout, but sections are visible in the Wankulwe and Mkumbi rivers. The block is entirely bounded by faults, except to the east where the Coal Measures outcrop for a distance of 11,000 ft. and overlie the Basal Sandstones which rest unconformably on the gneiss basement. The Coal Measures are of normal thickness, but the Basal Sandstones are 60 ft. thick and contain mauve sandstones and mudstones as

well as chocolate shales. To the south-west, the block rests against the Main Boundary fault; to the north and north-east it is divided by a fault from the Mkomolo block, and to the west and north-west it is probably bounded by two intersecting faults, but superficial deposits hide the geology. The general structure of the block is therefore a trap-door tilt block similar to that of Namwele. The strata dip from 25° to 45° to the south-west, except at the south-eastern tip where the dip is to the west.

Coal Deposits

Coal seams occur at the southern tip of the Wankulwe block, near the Wankulwe River; in the Mkumbi River and elsewhere in stream cuttings the Coal Measures contain no coal seams of any size. Some 600 ft. north of the Wankulwe River, near its confluence with the Muze River, a low bluff reveals about 6 ft. of coal with partings of shale. Near this outcrop a shaft was put down during the previous exploration without encountering the coal. In 1944, 1,250 ft. of pits were sunk over a strike length of 2,800 ft. in order to determine the importance of these coal seams. This work was carried out by W. J. Dorrell under the direction of D. R. Grantham. The pitting showed that the Coal Measures were displaced by a number of cross-faults and were cut out to the south by a fault which is probably a satellite of the Main Boundary fault. The coal was found to thin out in both directions and pinches out 400 ft. to the north and 600 ft. to the south of the outcrop; it is therefore of no economic importance, as the reserves are likely to be less than half a million tons.

The Mkomolo Coal Basin

The Mkomolo Karroo block is the continuation of the Namwele basin to the north-west of the interruption caused by the faulting up of the Wimi gneiss bar; it also has the form of a trap-door tilt block with the basal unconformity of the Karroo outcropping along the north-east margin. The block is about four miles long; it is narrow to the south-east, but over a mile across in the north-west in which direction it disappears beneath a cover of superficial deposits so that the actual extent cannot be measured. Coal seams outcrop along the north-easterly edge of the block and two shafts were sunk by G. Poultier in 1935; shaft No. 2 to 40 ft. 8 in., and No. 3 to 29 ft.

The Mkumbi and Tambalala rivers cut right through the Mkomolo block and expose a faulted inlier of gneiss. To the north-west of these rivers are rounded hills typical of the Upper Sandstone topography.

Geological Formations

The *unconformity* at the base of the Karroo is very clearly exposed at the point where the path from Namwele to Mkomolo

crosses the Tambalala River. The upper surface of the underlying gneiss passes upwards gradually to a quite unsorted breccia of irregular fragments of gneiss, large crystals of felspar, pebbles of quartz, etc., in a matrix of sand; this is not really a basal conglomerate but the result of the gradual invasion by swampy waters which re-sorted the decomposed upper portion of the gneiss, into which pre-Karroo weathering had penetrated deeply. The conglomeratic beds are only a few feet thick and pass downwards without discernible limit to the decomposed gneiss; they are surmounted by 20 to 30 ft. of *Basal Sandstones* similar to those at Namwele. The Basal Sandstones appear to thin out to the north-west and are reported as only two feet thick beneath the coal in shaft No. 3; further work is, however, necessary before this feature is definitely established.

The outcrop of the *Coal Measures* can be followed for about 15,000 ft. along the north-east margin of the Mkomolo block; on the left bank of the Mkumbi River a segment of Coal Measures 1,500 ft. in length reposes on the faulted inlier of gneiss mentioned in the preceding section. Coal seams are exposed at the following points: (*a*) at the crossing of the Tambalala River; (*b*) in the vicinity of shafts Nos. 2 and 3; and (*c*) at the Mkumbi River outcrop.

The constitution of the *Calcareous Series* at Mkomolo is normal and the limestones are visible in the Tambalala River and at a number of other points. Peculiar to the Mkomolo area are the dark, platy, micaceous sandstones and mudstones comparable to flagstones which form the summit of the Calcareous Series; they are about 100 ft. thick at the Tambalala River and cause waterfalls in all the rivers that cross them.

The *Upper Sandstones* are similar to those at Namwele, but a thickness of some 1,500 ft. only is present owing to faulting. The Intermediate Arkoses are well represented and can be seen outcropping in the slopes above shaft No. 2; they also occur in the upper Tambalala valley, where they are brought up by satellite faults similar to those of Wimi.

Structure

The general outlines of the structure of the Mkomolo Karroo block are similar to those of the Namwele block. The Karroo strata dip from 20° to 30° to the south-west, and are in the form of a long narrow wedge of which the thin end is the outcrop of the basal unconformity along the north-east margin. The narrow south-east end of the block is terminated by the transverse fault which has hoisted up the Wimi Gneiss Bar, and the north-western end disappears beneath a superficial cover and may either be faulted or in the form of a basin termination as at Namwele. The long south-western margin is caused by a powerful fault similar in nature and direction to the Main Boundary fault, of which it may be a branch; the minimum vertical displacement is 1,500 ft., but there

may also be horizontal movement. The trace of this fault across the valley of the Mkumbi River indicates that its hade is vertical; and the occurrence of the Intermediate Arkoses in the upper valley of the Tambalala is evidence of satellite faults similar to those described in the Namwele block. Between the Mkumbi and Tambalala rivers this boundary fault brings the Karroo rocks of the Mkomolo and Wankulwe blocks into juxtaposition.

An important feature of the Mkomolo block is the inlier of gneiss which is faulted-up in the Tambalala-Mkumbi area. The outlines of this inlier are irregular and its presence is due to both longitudinal and transverse faults. The repetition of the base of the Karroo strata and the outcrop of Coal Measures on the left bank of the Mkumbi River are due to this faulting. The presence of this inlier indicates that the coal seams in the Mkomolo block may be more broken by faults than in the Namwele block.

Coal Deposits

In the Mkomolo coal basin the only coal seams of commercial value are those that have been explored by shafts Nos. 2 and 3. If these seams are continuous beneath the superficial cover, the total strike length will be about 4,000 ft. There are indications that the coal outcrop has been displaced by small transverse faults, and it is important to note that at every outcrop the coal appears to be shattered. Sections in these two shafts have been measured by G. Poultier; 5 ft. of "very good coal" is noted in the bottom of shaft No. 2 and a seam of 4 ft. of coal in shaft No. 3, but the correlation of the seams between the two shafts is not at all clear. Shaft No. 2 was re-opened by D. R. Grantham in 1942 and the seam of coal measuring 3 ft. 10 in. was sampled; it was found to be similar in quality to the Namwele coals. All the seams examined in the shaft are slickensided and shattered; they contain more shale partings than is indicated in the sections (Pl. IV).

An important feature of the coal seams at Mkomolo is the apparent absence of the thick Basal Sandstones which occur at Namwele. In consequence, the coal seams at the outcrop are only separated from the gneiss forming the floor of the Karroo strata by a few feet of sandstones and shales. In shaft No. 3, only 2 ft. of shaly sandstone separate the 4 ft. seam of coal from the gneiss; shaft No. 2 did not reach the gneiss, but the adjacent outcrops indicate that the thickness of the Basal Sandstone will not exceed 10 ft. There is good reason to believe that the thinning of the strata at the base of the Coal Measures is due to non-deposition owing to a shallowing of the basin, but without further exploration the presence of faulting cannot be completely excluded. It has already been pointed out that any irregularity in the original gneiss surface might cause the Coal Measures to be cut out completely, especially where the strata are very thin. Reasons are given above (*see* p.237) for believing that the original surface of the gneiss was

very flat and that the 70 ft. of strata between the coal and the gneiss basement at Namwele was sufficient to render improbable any extensive non-deposition of the coal owing to the presence of islands, but in the Mkomolo basin the continuity of the coal seams cannot be regarded as certain.

Seams of coal up to 2 ft. in thickness have been found on both sides of the Tambalala valley near where it is crossed by the path from Namwele to Mkomolo. These seams have only a short strike, and their footage down the dip would be limited by the faulting which has brought up the gneiss inlier; there is, perhaps, half a million tons of coal available here.

The occurrence of coal seams on the left bank of the Mkumbi River has been mentioned in the preceding section. The following sequence was measured, from top to bottom, in a gully on this outcrop:

Carbonaceous shales	1 *ft.* 6 *in.*
Dark marly carbonaceous sandstone	4 „ 0 „
Carbonaceous shales with some small seams of coal	2 „ 0 „
COAL, weathered	1 „ 8 „
Hard band of dark marly carbonaceous sandstone	2 „ 0 „
Alternation of carbonaceous shale and thin seams of coal	1 „ 2 „
COAL, rather platy	2 „ 0 „
Carbonaceous shales	0 „ 6 „
Grey marls	0 „ 9 „
Light-coloured rather argillaceous sandstones	2 „ 0 „
Basal Sandstones	About 30 „ 0 „

The Basal Sandstones here pass down to the weathered surface of the gneiss in the manner that has been described in the section on Namwele. The coal seams in this outcrop have no appreciable length of strike, and when followed down the dip will be cut out in less than 1,000 ft. by the south-westerly boundary fault of the Mkomolo block and its satellite faults. The reserves available at Mkumbi may be taken as roughly half a million tons.

Estimation of Reserves

It is not possible to give any reliable estimate of the coal reserves available in the Mkomolo basin, as insufficient exploration work has been done. The geological survey has shown that the area of possible exploitation is considerably smaller than at Namwele, and that the basin is more dislocated by faults. The most promising area for exploitation is that lying to the west of shafts Nos. 2 and 3. The seams of the Tambalala and Mkumbi rivers would yield small amounts of coal, as has been mentioned in the preceding section.

The strike of the coal seams in the vicinity of shafts Nos. 2 and 3 may be estimated at 4,000 ft.; a programme of pitting would be necessary to confirm this figure. The coal seams in shaft No. 2 total some 8 ft. in thickness, but they are spread over a vertical distance of 20 ft. and hence would not all be exploitable. The more compact seams in the bottom of the shaft total 5 ft. in thickness,

and in shaft No. 3 one seam is given as 4 ft. thick. Therefore a figure of 4 ft. has been taken as the average thickness of exploitable coal.

The distance to which the coal seams can be pursued down the dip to the south-west is highly problematical, but the first clearly defined satellite of the boundary fault in this direction is 4,000 ft. distant horizontally and this distance is adopted as the limit to which the coal seams may extend.

It must be emphasised that it is impossible to say whether the coal seams cover the whole of the area defined above, or whether they do not perhaps extend further to the north-west than has been assumed, and, of course, the average width of coal may vary widely; for these reasons the following estimate must be considered as only a rough indication of the possible reserves.

The area supposed to be underlain by coal seams totals some 300 acres, and, therefore, assuming an average thickness of 4 ft., a dip of 25° and an extractable quantity of 100 tons per inch per acre, the available coal would amount to 1½ million tons.

The total indicated coal reserves in the Mkomolo basin would therefore be:

Principal Coal Area . . .	*tons*	1,500,000
Tambalala River Seams . .	,,	500,000
Mkumbi River Seams . .	,,	500,000
Possible Total .	,,	2,500,000

Nature and Origin of the Coal

The Namwele coal is platy and finely stratified; it consists of layers up to 1 cm. in thickness of hard splintery material with a rather dull lustre separated by fine streaks of vitrinite from 1 to 3 mm. thick. The dull layers resemble the durain of European coals but sparkle with many bright points and may pass to a hard coal with quite a bright lustre. Thin layers and skins of fusain are frequent and range up to 2 mm. in thickness; the coal often breaks along a layer of fusain and shows a carbonised aggregation of fragments of unrecognisable plants resembling reeds. Pyrite exists in the form of nodules and of pyritised fragments of vegetation. All degrees of passage between normal coal, coal-shales and carbonaceous shales can be found as the content of mineral matter forming the ash increases. All the coal tends to break into slabs rather than lumps, and the proportion of fines on breaking is high. The slabs break up easily in the open fire and burn freely with a long smoky flame. Below 200 ft. vertical depth in the workings the hardness of the coal increases, apart from the shattered zones, and a smaller proportion of fines is produced on breaking.

Microscopic Examination

Time has not been available for the careful preparation of the

slides required for a detailed examination of the microscopic texture of the coal. Thin sections show that the coal is finely banded with vitrinite and durain layers. The vitrinite is in bands up to 3 mm. in thickness; no structure could be seen in it, but more careful preparation would probably reveal some cellular texture. The durain is interleaved in the vitrinite and also forms microscopic inclusions in it. It has a flattened granular texture with a grain size of about 0·1 mm.; the grains are translucent and may represent spores. It is in these durain layers that most of the ash is concentrated; numerous minute grains of silica can be seen. A slide was prepared of the ash residue after burning some finely-ground coal; the ash was seen to consist mainly of small particles of amorphous or crypto-crystalline clay, some ovoid granules of opaline silica probably representing spores, grains of pyrite or marcasite, very small particles of quartz and rare shreds of biotite. The fine grain of the ash means that very fine grinding would be necessary in any cleaning process. A. Duparque (1934), in a memoir accompanied by excellent plates, has described the microscopic texture of coals of the Luena and Lukuga Karroo basins in the Belgian Congo, which closely resemble the Namwele coals. He finds that they are composed mainly of spores, grains of pollen, sections of leaves and finely divided woody and cutinous material with comparatively little gelatinous, amorphous or colloidal matrix. He adds: " . . . by the presence of resins and the alteration of the woody tissues, these Permian coals, rich in cutin, appear to be the same type as the bituminous coals of the Westphalian stage " . . . . (i.e. Middle Upper Carboniferous of the Franco-Belgian coalfields). Duparque points out that the high proportion of volatile matter to fixed carbon (low fuel ratio) of these coals is similar to cannel coal, but the latter is characteristically homogeneous in structure, and so unlike the streaky Namwele coal.

Chemical Composition

Chemical analyses of the Namwele coal as well as the results of beneficiation and utilisation tests carried out by the Imperial Institute are given in the Appendices to this paper. Some of the work done by the laboratory of the Geological Division in Dodoma is also recorded in an Appendix. The composition of the coal may be judged from the two following analyses in which " A " represents the average of 24 samples of individual seams of the Main Coal taken by W. J. Dorrell in the First Level, and " B " represents lumps and plus ½ in. fines handpicked by the following simple method which was developed on the mine by W. J. Hughes. The run-of-mine coal was screened on a 1 in. grizzly: the oversize was handpicked and the undersize screened in a ½-in. trommel. The minus 1 in. plus ½ in. material was then handpicked on a moving belt, the minus ½ in. material being discarded.

Proximate Analysis (*air-dried coal*)	*A* (*per cent.*)	*B* (*per cent.*)
Moisture	5·3	3·9
Ash	31·2	25·5
Volatile	30·2	33·9
Fixed Carbon	33·3	36·7
Sulphur	7·2	6·6
Volatile matter, dry ash-free	*47·6*	*48·1*

	A	*B*
Calorific Value, B.Th.U/lb.	8,150	9,400
Ditto, moist ash-free	11,850	12,580
Coking qualities	nil to weak	weak

The chemical characteristics of the Namwele coal may be summed up as follows: (*a*) high proportion of ash; (*b*) high ratio of volatile combustible matter to fixed carbon (i.e. low fuel ratio); (*c*) high sulphur content; and (*d*) non-coking.

Classification

It is difficult to fit the Namwele coal into any of the accepted classifications on the basis of proximate analysis alone. The chemical composition resembles that of a cannel coal, but cannel coals do not contain vitrinite and are of homogeneous texture. Microscopic examination shows a high grade of coalification, therefore the coal must be classed as bituminous, and the high proportion of volatile matter to fixed carbon indicates that the Namwele coal is a high-volatile bituminous coal with a high ash and sulphur content.

According to the calorific value as calculated on a moist, ash-free basis this coal ranks in the classification of the American Society for Testing Materials in Class II, Group 5, High Volatile C Bituminous Coal.

Probable Origin

The Namwele coals appear to have formed from drifted vegetation accumulating in shallow lake basins. The absence of conglomerates from the Basal Sandstones, and the gentle mode of invasion by the Karroo waters has already been described. The Coal Measures are characterised by an even finer type of sedimentation; grits are almost completely absent and sandstones rare. This type of sedimentation may mean shallow water surrounded by a flat land surface rather than deep water far from land, and the former interpretation is supported by the intimate inclusions of shale in the coal. No ravining or washouts of the coal seams have been observed anywhere in the Namwele workings.

No fireclay or seat earth has been observed anywhere at the base of coal seams. The only possible exception to this rule is at Mweranganda where the lowest coal seam is underlain by a fireclay and may have formed almost *in situ* in a swamp on the margin of the coal basin. Large fragments of tree trunks and stumps are also absent. The drifted origin of the coal is further attested by the frequent alternations of coal, coal-shales and carbonaceous shales, the high ash content of the coal and the finely divided

stratification of the bright and dull layers. These conclusions support the general concensus of opinion (e.g. Lightfoot, 1929, pp. 29-30 ; Stockley, 1938, p. 30, and Duparque, 1934, pp. 109-113) that the coals of Central Africa were laid down in lake basins.

Many fragmentary plant remains are found in the coal ; they are always small and none seem to be determinable. They occur mainly in the layers of fusain and present a very irregular appearance suggesting a deposit on the bottom of a lake. Fragments of vegetation completely replaced by pyrite are quite frequent, and a careful study of them might lead to conclusions as to the nature of the vegetation groups from which the coal has been formed. The absence of determinable fossils at Namwele is a remarkable feature and may be due to a high content of sulphur in the water during the deposition of the coal.

List of Works Consulted.

DUPARQUE, A. 1934. Contribution a l'étude pétrographique des houilles de la Lukuga et de la Luéna. Comité Spécial du Katanga. *Ann. Serv. Min.*, Vol. **5**, pp. 69-147.

FOXWELL, G. E. 1944. The Underground Gasification of Coal. *Iron Coal Tr. Rev.*, Vol. **149**, No. 3991, pp. 257-259 & 268.

JAMOTTE, A. 1931. Contribution à l'étude géologique du bassin charbonnier de la Lukuga. Comité Spécial du Katanga. *Ann. Serv. Min.*, Vol. **2**, pp. 3-35.

—— and F.-F. MATHIEU. 1934. L'extension de l'étage de la Lukuga (Système du Lualaba-Lubilash) dans le Katanga septentrional. *Bull. Soc. belge Géol. Pal. Hydr.*, Vol. **44**, pp. 446-459.

—— 1944. Études des sondages de Kipula (Sud-Katanga). *Comité Spéc. Katanga, Octobre*, 1940. Elisabethville, 1944.

LIGHTFOOT, B. 1914. The Geology of the North-Western Part of Wankie Coalfield. *Bull. No.* 4, *Geol. Surv. S. Rhodesia*, pp. 1-49.

—— 1929. The Geology of the Central Part of Wankie Coalfield. *Bull. No.* 15, *Geol. Surv. S. Rhodesia*, pp. 7-61.

STOCKLEY, G. M. 1931 (A). Report on the Geology of the Ruhuhu Coalfields. *Bull. No.* 2, *Geol. Surv. Tanganyika.*

—— [and OATES, F.]. 1931 (B). The Ruhuhu Coalfields, Tanganyika Territory. *Min. Mag., Lond.*, Vol. **45**, No. 2, pp. 73-91.

—— 1932. The Geology of the Ruhuhu Coalfields, Tanganyika Territory. *Quart. J. Geol. Soc. Lond.*, Vol. **88**, pp. 610-622.

—— 1936. A further contribution on the Karroo Rocks of Tanganyika Territory. *Quart. J. Geol. Soc. Lond.*, Vol. **92**, pp. 1-31.

—— 1938. The Geology of parts of the Tabora, Kigoma, and Ufipa Districts, North-West Lake Rukwa. *Short Paper No.* 20, *Geol. Div., Dept. Lds. Mines, Tanganyika.*

TEALE, E. O. 1929. Namwele Series. *Ann. Rep. Geol. Surv. Tanganyika*, 1928, p. 19.

—— 1934. Galula Coalfield. *Ann. Rep. Geol. Surv. Tanganyika*, 1934, p. 55.

—— 1936. Provisional Geological Map of Tanganyika with Explanatory Notes. *Bull. No.* 6, *Geol. Div., Dept. Lds. Mines, Tanganyika.*

WYBERGH, W. J. 1922-25-28. The Coal Resources of the Union of South Africa. *Mem. No.* 19, *Geol. Surv. S. Africa.* 3 vols.

The Appendices referred to in the above article will be published in the next number of this BULLETIN.

RECENT DEVELOPMENTS IN THE BRITISH PETROLEUM DRILLING CAMPAIGN

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The search for oil in Great Britain, which has been in progress since 1936, has resulted in the discovery of six oilfields, four in Nottinghamshire and two small fields in Lancashire and the Midlothian area of Scotland. The earlier activities were described by J. Simpson, M.Sc., F.G.S., of the Mineral Intelligence Section of the Imperial Institute, in an article in this Bulletin (1939, **37**, 88-103) entitled "The British Petroleum Drilling Campaign." The present article aims at summarising the subsequent developments in exploration and production.

Nearly all the exploration work has been shared between the D'Arcy Exploration Co., Ltd. (exploration subsidiary of the Anglo-Iranian Oil Co., Ltd.) and the Anglo-American Oil Co., Ltd. The Gulf Exploration Co. (Great Britain), Ltd., and Messrs. Steel Bros. & Co., Ltd., who also participated in the search on a minor scale, though unsuccessfully, have now surrendered all their licensed areas. The results of the investigations of the D'Arcy Company during the period 1937-1944 have been recorded in detail by Lees and Taitt (*Quart. J. Geol. Soc. Lond.*, 1946, **101**, 255-317); wartime operations in the oil-producing areas developed by the company have been described by Southwell (*J. Inst. Petrol.*, 1945, **31**, 27-39). The more recent work of this company, and the work of the other companies since the outbreak of war, have been reviewed in various issues of the *Petroleum Times*.

The search has been carried out in seven separate geological provinces—the Lower Carboniferous of the Midland Valley of Scotland; the Carboniferous of the Carlisle Basin; the Permian and Jurassic of North-East Yorkshire; the Triassic and Carboniferous of Lancashire and the Cheshire Basin; the Carboniferous of the Midlands, South Yorkshire and Eastern England; the Carboniferous of South Wales; and the Mesozoic of Southern England.

Scotland

Nos. 2 and 3 of the D'Arcy Company's Cousland borings failed to yield any oil. Shallow drilling for structural information was carried out in the Pentland Fault zone, and on the Balfour anticline in Fifeshire, but the outbreak of war made it necessary to suspend operations in Scotland. The search was resumed in 1944 with a boring on the Salsburgh anticline in Lanarkshire, which proved a very small quantity of gas only, and was abandoned at 4,267 ft. A borehole at Blackness, five miles west of Queensferry, which was commenced in June, 1945, and completed at 2,455 ft., gave a small showing of oil and gas. Another well in the same area, at Easter

Pardovan, was drilled to a depth of 3,183 ft., but only a little gas was encountered.

In the Midlothian area, in addition to the pre-war producing well (No. 1), the Anglo-American Company have drilled five wells, of which three were dry, one was a gas well, and the other (No. 3) gave much the same oil yield as No. 1, which so far has remained fairly constant in its output. The total production to June 30, 1946, was 2,083 tons, and reserves of natural gas were estimated at 600,000,000 cu. ft. Well No. 6 has been deepened to reach gas-bearing sands proved in No. 1, with a view to distributing the gas to local industry, but the production obtained was far below that expected. In Fifeshire, a well was drilled to 2,703 ft. at Masterton, but gave only one slight show of oil.

Carlisle Basin

Geophysical exploration of the Carboniferous of this region was carried out by the Anglo-American Company, but their licences have now been surrendered.

North-East Yorkshire

The D'Arcy Company's Eskdale No. 2 boring encountered no oil, but proved capable of gas production, probably on a commercial scale. The boring, which was continued to 5,040 ft., also revealed the first known occurrence in Britain of potash salts in the Permian. A well at Lockton, 13 miles west of Scarborough, drilled during 1945 to test the oil possibilities of the Middle Jurassic sandstones, reached a depth of 1,499 ft. without encountering more than small traces of oil.

The Anglo-American Company carried out detailed gravity surveys of their licensed areas, and drilled a number of shallow structure holes on the Redcar anticline.

The Gulf Exploration Company drilled a well in the Cleveland Hills, 18 miles west of Aislaby, to a depth of 6,283 ft., encountering only some evidence of gas.

Lancashire and Cheshire Basin

Petroleum indications in the Formby area were known over three centuries ago, and described in a paper read in 1843. Attention was redrawn to them in 1936 in this Bulletin (**34**, 241). On June 10, 1939, a boring drilled by the D'Arcy Company to investigate the source of oil seepages in an area of peat, struck oil at 125 ft. in the Keuper Waterstones. The initial production was about three tons per day. In the drilling up of this accumulation and in the search for similar accumulations in the area, 45 shallow wells, 19 of which were production wells, have now been put down, the total footage being 12,489 ft.; the drilling was performed with the Failing portable outfit used for drilling seismic shot-holes. In an attempt to find the ultimate source of the oil, torsion balance and

seismic refraction surveys have been made, and two exploration wells have been drilled, one in the Downholland area to a depth of 6,382 ft. (unfinished), and the other, five miles to the north-east of the former, to a depth of 5,735 ft. The problem, however, remains unsolved.

The structure of this oilfield, which extends over some 30 acres, is a faulted monocline with a slight culmination, the oil being capped by boulder-clay. The oil-column in the Keuper Waterstones is small. Oil has also been obtained from the upper beds of the underlying Keuper Sandstone and from a sand within the overlying boulder-clay. In general character the oil resembles that of the Eakring area. The highest production rate in this field was in July, 1940, when six tons were obtained daily from 11 wells. From the commencement of production to 30th June, 1946, a total of 6,938 tons was produced.

The Anglo-American Company carried out detailed gravity surveys of their licensed areas in Lancashire, and throughout the Cheshire Basin, supplementing this work with some trial reflection shooting. Most of their licences in this region have now been surrendered.

Midlands, South Yorkshire and Eastern England

Derbyshire

A boring to a depth of 2,555 ft., which proved barren, was put down by Messrs. Steel Bros. near Ashopton, north of the Edale Valley.

Hardstoft No. 1, for many years the only oil-producing well in Britain, yielded, after reconditioning, 1,227 tons of oil up to 30th June, 1946. The daily production, however, had decreased to one-third of a ton in 1944.

The Nottinghamshire Oilfields

An analysis of colliery data and coal exploration borings, followed by geophysical surveys, led to the drilling of a well by the D'Arcy Company at Eakring, where oil was struck on June 19, 1939, at 1,912 ft. in sandstone of the Rough Rock, the topmost member of the Millstone Grit. On test, the well proved capable of a production of 12 tons per day. At the outbreak of war, it was decided to concentrate effort on oil production drilling and on exploration in the immediate vicinity of Eakring, at the expense of various scattered projects elsewhere. As a result, oil accumulations were discovered at Kelham Hills, Duke's Wood and Caunton.

Progressive improvements in the use of the original heavy drilling equipment resulted in reducing the time taken to drill a well from seven weeks in 1940 to three weeks in 1942, but the time required in moving from one site to another remained at two weeks. At the beginning of 1943 four new drilling outfits, combining a jack-knife portable mast and unitised draw-works, together with

the specialised transport necessary, were purchased from the United States; with these outfits the drilling time averaged seven days and the moving time 12 hours. The drilling was carried out by the rotary mud-flush system, and the outfits were fitted with penetration recorders. The latter, in conjunction with rock samples from the drilling fluid, provided the evidence for correlating the strata. Rock bits were required throughout the drilling, and very careful control of the fluid proved necessary, the mud being conditioned with bentonitic clay. Verticality of the holes was maintained by constant checks with a single shot recorder. One string of casing was usually sufficient for the wells, but excessive circulation losses in fissured formations occasionally necessitated cementing a surface conductor string. Wells are now completed with a perforated liner.

The following table summarises the salient points relating to these oilfields:

Oilfield.	Oil Reservoirs.*	No. of wells drilled.	No. of wells successful.	Total footage drilled. (*Ft.*)	Productive area. (*Acres*)	Production to June 30, 1946. (*Tons*)
Eakring . .	1-6	175	170	375,630	600	321,982
Duke's Wood .	1-3, 5-7					
Kelham Hills .	3, 6	62	56	145,980	180	93,429
Caunton . .	3, 6	16	11	37,188	50	14,617
		253	237	558,798	830	430,028

* Oil Reservoirs: *Coal Measures*, Wingfield Flagstones (1), B Sandstone Group (2); *Millstone Grit*, Rough Rock (3), sandstones between the Rough Rock and the Longshaw Grit (4), Longshaw Grit (5), Chatsworth Grit (6); *Lower Carboniferous*, limestone and shale (7).

The oilfields occupy structural culminations on a gently-folded compound anticline, and only small faults appear to be present. The seismic refraction surveys, from which the structural conditions were deduced, registered on the Carboniferous Limestone, but owing to the variable thickness of the Millstone Grit, it became necessary during development of the area to construct a separate structural contour map for the top of the latter series. The oil horizons are separate, independent, and sometimes lenticular, the most important being the Rough Rock, which is up to 100 ft. in thickness; they vary considerably in porosity (0 to 20 per cent.) and permeability (2 to 1,000 millidarcies). Duke's Wood No. 146, the test well which proved the oil horizon in the Lower Carboniferous, was continued, in view of its importance for an understanding of the regional geology, to 7,476 ft., the greatest depth yet reached in Britain.

The oil-columns, which are small, vary with the different reservoirs. The original reservoir pressure was such that the earliest wells would flow, but all wells are now operated by pumping. The Rough Rock at Eakring and Duke's Wood, and its supposed

representative at Kelham Hills, the Upper Grit, have very incompetent water drive, if any, and appear to be controlled by gas expansion. The remaining reservoirs are believed to be governed by water drive. Well spacing was planned on a basis of one well to 2½ or 3 acres. Although the gas saturation pressures of the crudes vary over a wide range, they were all, at their original pressure, considerably undersaturated. There is a remarkable variation in the temperature gradients of the rocks in the different fields.

The crude oils are greenish-brown in colour, and their specific gravities range from 0·828 to 0·892. They are characterised by low sulphur- and asphalt-contents and high wax-contents, being essentially paraffinic in nature. The motor and aviation gasoline distillates have high octane numbers and non-knocking properties. Lubricating oils of high grade can be prepared. The oils vary between the fields and between the reservoirs within the individual fields; the edge-waters also vary thus, showing considerable differences in both type and concentration.

The oil is pumped electrically to gathering stations, thence to a railway siding, from where it is transported by rail-car to Lobitos Oilfields' refinery at Ellesmere Port, Cheshire. The gas from the wells is treated to recover the gasoline, the stripped gas being used for fuel. The two main production problems have been connected with water separation and with the settling of wax in the surface lines and the upper portions of the wells. Water separation is effected by means of vertical separators heated by steam coils, and by a gas-fired separator; de-waxing of the surface lines is performed with go-devils, and of the wells by electrical heating of the top 1,000 ft. A number of experiments, of which shooting has proved the most effective, have been performed to increase the yield from the reservoirs.

These oilfields are profitable to exploit, and their size, though modest, is comparable with that of the average oilfield of the Mid-Continent areas of the United States. Production from them will continue for some years at a steadily declining rate.

Other Areas

Seismic surveys, followed by exploration drilling, were extended to the *north-east, east and south of the Nottinghamshire oilfields* by the D'Arcy Company. No useful results could be obtained by the reflection method, but the refraction arc method was developed to a degree of precision far beyond that thought possible at the outset. In all, 22 anticlines or areas of possible stratigraphic traps were tested by 39 wells, but, although in many cases oil shows were recorded, production was obtained in only one case, Nocton No. 2 (near Lincoln), which yielded about 40 tons of oil from the Carboniferous Limestone. As a by-product of the search for oil, these borings have proved the absence of important coal seams over large areas where they might have been expected, and

the existence of workable seams in other areas where they were hitherto unknown.

Exploratory work in *Norfolk* has proved the absence of Carboniferous rocks at North Creake, where a borehole was drilled to a depth of 2,632 ft., encountering pre-Carboniferous rocks, immediately below the Permo-Triassic, at 2,435 ft. In January, 1943, three licences were issued covering an area of 569 sq. miles in Norfolk, but these licences expired in January, 1946.

In *South Yorkshire*, the D'Arcy Company began drilling a well near Market Weighton at the beginning of July, 1946.

The Anglo-American Company carried out sub-surface geological mapping in the region of the *Nottinghamshire-Yorkshire Coalfield*, as a result of which a structural map of the Barnsley coal seam was constructed over the whole of the exposed and concealed parts of the coalfield. Magnetic, gravity and seismic (reflection and refraction) surveys were also carried out, and for the first time the geochemical method of exploration was used in Britain. Five wildcat wells were drilled in the region, but without any success, although numerous shows of oil were discovered. In addition, a well drilled at Belton, 13 miles east of Doncaster, and completed in the summer of 1945, reached a depth of 5,459 ft. in the Carboniferous Limestone without recording more than traces of oil. Drilling was commenced early in 1946 at Gringley-on-the-Hill, 13 miles south-east of Doncaster ; this boring has recently shown traces of oil in the Millstone Grit, at a depth of 4,897 ft. Samples of coal were collected for the Coal Commission from the seams penetrated by this boring.

South Wales

The Carboniferous of the South Wales Coal Basin was tested by the Anglo-American Company with a well at Pontypridd. Drilling was continued to a depth of 2,749 ft. in the basal Millstone Grit, but no show of oil or gas was noted.

Southern England

Drilling by the D'Arcy Company in the Dorsetshire coastal region was suspended at the outbreak of war. All prospecting licences in Southern England were subsequently relinquished.

Newly Licensed Areas

Since the cessation of hostilities in Europe, prospecting licences have been taken out in the following areas of Britain :

Area.	Extent. (*Sq. miles*)	No. of Licences.	Counties in which Licences are Situated.
D'Arcy Exploration Co., Ltd.			
A	190	1	North-East Yorkshire, South Durham.
B	753	4	Mainly West Riding of Yorkshire.
C*	120	1	Mainly Derbyshire.
D	198	1	Cheshire.
E	393	2	Shropshire, Staffordshire, Derbyshire.

Area.	Extent. (Sq. miles)	No. of Licences.	Counties in which Licences are Situated.
F	3,562	19	Worcestershire, Warwickshire, Gloucestershire, Oxfordshire, Northamptonshire, Buckinghamshire, Somersetshire, Wiltshire, Berkshire, Hampshire.
G	1,869	10	Buckinghamshire, Hertfordshire, Essex, Berkshire, Middlesex, Hampshire, Surrey.
H*	310	3	Wiltshire, Dorsetshire, Hampshire, southern part of Isle of Wight.
Anglo-American Oil Co., Ltd.			
I	670	4	Mainly North Riding of Yorkshire.
J	1,786	11	Wiltshire, Hampshire, Dorsetshire, northern part of Isle of Wight.

* *Area has been previously licensed and abandoned by the company.*

Area A.—Seismic surveys have been carried out south of the Tees estuary. A well at Kirkleatham reached a depth of 3,736 ft. in the Carboniferous, proving a small gas production in Permian limestone, but only insignificant traces of oil. A second well at this locality, drilled during 1946, was completed at a depth of 3,091 ft. in the Carboniferous; small gas shows were again encountered in the Permian.

Area B.—Geological survey work in the area north of Harrogate was followed by the testing of anticlines at Aldfield and Sawley; and seismic surveys in the country north, east and south of Boroughbridge led to the sinking of a well on an anticlinal structure at Ellenthorpe. This boring was abandoned at 3,598 ft. in Lower Carboniferous limestone without having encountered oil or gas shows of significance. The licences covering this area have recently been surrendered.

Area C.—This area includes the Hardstoft well. Further geological investigations were carried out in the area in which a number of wells were drilled in the 1918 drilling campaign, and a test well was drilled at Whittington, on the Brimington anticline three miles north of Chesterfield. Only minor gas and oil shows were found in this well, which was abandoned at 3,369 ft. in Lower Carboniferous limestone.

Area E.—A magnetometer survey has been initiated in Staffordshire, to the east of Market Drayton.

Areas F and G.—Nearly all of Area F, and the whole of Area G, is virgin territory in the search for oil in Britain. A gravity survey is in progress in Wiltshire in the area east of the Bath-Bristol Coalfield, and in Gloucestershire.

Area H.—Drilling was recommenced in January, 1946, in the Dorsetshire coastal zone at Chaldon Down No. 2 well, which was completed at 1,793 ft. in the Kimeridgian. A gravity survey of this area has also been carried out.

Area I.—Some geological field work was carried out in the Cleveland Hills region in 1945.

Area J.—A gravity survey has been completed recently over

Hampshire and Salisbury Plain and is now being followed by detailed three-dimensional mapping of certain geological horizons.

Production

British crude oil production at the outbreak of war was at the rate of about 300 tons a month; production reached its peak rate of just over 10,000 tons in September, 1943; the present production rate from 240 wells is about 4,500 tons a month. The annual production, in tons, of the D'Arcy Company is as follows:

1939.	1940.	1941.	1942.	1943.	1944.	1945.	Total.
3,136	16,689	29,990	81,298	112,609	94,414	71,427	409,563

By June 30, 1946, Britain had produced a total of about 440,000 tons of good-quality oil, and an area of about 16,000 sq. miles was still covered by prospecting licences.

In conclusion, acknowledgement is gratefully made to the D'Arcy Company, the Anglo-American Company, and the Petroleum Division, Ministry of Fuel and Power, for reading the proofs of this article.

ABSTRACTS AND NOTES

The Black Rock Manganese Deposit in the South-Eastern Kalahari.—A paper under this title by L. G. Boardman appeared during the war in a South African publication (*Trans. Geol. Soc. S. Africa*, 1942, **44**, 51-60) that has only recently become generally available and from which the following notes are taken.

The deposit, the working of which was commenced by the Associated Manganese Co. in April 1940, lies about 45 miles north-west of Kuruman. The nearest railhead is at Lohathla, 88 miles to the south, near the centre of the Postmasburg manganese fields. The Black Rock forms a low hogsback of banded ironstones, presumed to belong to the lower Griquatown series, in which bodies of manganese ore are present. It is the only outcrop in a sea of sand, and, as the highest point is nearly 100 ft. above the nearly flat surface of the surrounding sand, it forms a conspicuous landmark.

The outcrop is roughly oval, measuring 520 yds. in length and 200 yds. in width. Indistinct swells in the sand, coinciding with the continuation of the strike of the exposed banded ironstones, probably indicate their sub-surface extension. If so, and if these extensions are similar to the outcrop, they will contain a great additional reserve of manganese ore.

The strata forming the hill dip westwards at 25° to over 40°. It is inferred that the hill represents a monoclinal fold tilted to the west. The eastern side exhibits a series of low cliffs, while the remainder has a gentle slope to the west. At the cliff outcrop, intercalated between the banded ironstones, with sharp junctions, are layers of manganese ore varying in thickness from about 3 ft. to 25 ft., and averaging about 10 to 15 ft. The intervening banded

ironstones vary from about 6 ft. to over 70 ft. in thickness. The manganese ore consists almost wholly of manganese oxides in crystalline forms. The evidence indicates that in all probability the ore is a result of chemical replacement of the banded ironstones subsequent to tectonic disturbances. The silica of the banded ironstones, and more or less of the haematite, were replaced by the manganese oxides. This process of replacement has not been haphazard but has taken place along well-defined zones.

The depth to which the manganese layers extend downward is not known, but it is believed that the manganisation has proceeded at least to the level of the sand, i.e. about 150 ft. down dip from the outcrop. However, even this represents only the smaller and upper half of the hill formerly exposed to weathering, for the base is swathed in sand to a depth of nearly 100 ft. vertically. It is therefore concluded that if manganisation proceeded down to the pre-Kalahari erosion level, the ore reserve will be more than doubled in quantity, although quality is almost sure to decrease with depth from the outcrop. It is also quite possible that ore extends along the sub-outcrop; indeed, a pit sunk in the sand opposite the point where an ore outcrop disappears struck ore at a shallow depth.

Whilst under present economic conditions ore deeper than 50 ft. down dip from the outcrop is said to be of little interest to the producer, the author nevertheless points out that in the environs of Black Rock is a field in which may lie unknown reserves of high-grade manganese ore of potential importance.

As at Postmasburg, the ores are hard and bright, and the same crystalline and massive varieties are found, with, in most of the ore, a marked banding. Haematite is by far the commonest impurity.

The following table of ore types and their approximate assay values is given:

Types of Ore and Approximate Assay Values

Type and Description	Approx. Mn. *per cent.*	Approx. Fe. *per cent.*	Quantity and Nature of Occurrence
Bright and fine-grained	53	6	Patches and bulky masses occurring in the main body
Fine-grained and streaky	49	10	Largely composes the ore zones
Dull and streaky	42	16	Bulks largely in the ore zones
Soft, heavy, spongy and shaly, with criss-cross ribbing. Soils the fingers and is covered with bright specularite scales	43	18	Fairly frequent lenses and pockets in the main orebodies
Coarse-grained and bright. (Apparently a mass of braunite, and/or sitaparite crystals)	50	11	Smallish lenses and pockets
Mottled and porous but hard; cavities lined with pyrolusite and wad	51	10	Small lenses and pockets

The first three of these types are obviously stages in the replacement of the banded ironstone, and together they form the great

bulk of the ore. In the quarry the first three types, which together constitute more than three-quarters of the ore, can only be distinguished from the adjacent banded ironstones by their bright blackish-grey appearance and the absence of chert bands. The last three types are very subordinate in mass to the main run of the orebodies; they occur as irregular and lens-like bodies from a few inches in diameter to 2 or 3 ft.

The following is a partial analysis on a bulky composite sample of the fine-grained and streaky, and dull and streaky types listed in the above table. It represents the general run of the massive ore: Mn 46·62, Fe 10·79, SiO_2 0·51, P_2O_5 0·13, Al_2O_3 1·38, combined water 2·20, moisture 0·18 per cent. The total manganese plus iron in these ores habitually adds up to between 56 and 61 per cent., showing that they are present in complementary amounts.

After 11 months operations the main orebodies proved to be 20 to 25 ft. thick in contrast to the 15 ft. as inferred from the outcrops. An incline down one of the main orebodies had progressed 100 ft. down the dip and for that distance the ore preserved much the same quality as at the surface. The partial analysis given above was found to be a fair reflection of the general run of ore. Sorting, of course, brings up the grade. The average grade of the ore is fairly high in spite of the iron content and this is ascribed to the prevalence of polianite-pyrolusite crystals in the ore cavities.

A. W. G.

Mineral Production of Sierra Leone.—The Chief Inspector of Mines reports the following mineral production statistics during the first half of 1946, with corresponding figures for 1945 shown in brackets.

Crude gold and unrefined gold bullion, 137 (187) troy oz., estimated to contain 127 (176) troy oz. fine gold. Coarse crude platinum, 69 (3) troy oz. Chromite, 800 (nil) tons. Exports of iron ore during the second quarter were valued at £155,398 (£202,061) Figures for the first quarter are not available.

The average number of African Labour employed in mining was 6,200 (5,840).

W. B.

Mineral Production of British Guiana.—The production of gold and diamonds in British Guiana during the first half of 1946 has recently been given by the Commissioner of Lands and Mines as follows, corresponding figures for 1945 being shown in brackets.

Gold	12,675 (8,418) troy oz.
Diamonds	10,624 (6,995) carats.

Royalty from gold amounted to £1,319 (£877) and from diamonds £333 (£219).

The increase in gold production was due chiefly to a cyanidation

plant put into operation by the Cuyuni Goldfields, Ltd., on their mining concession in the Cuyuni River, and to dredging by the British Guiana Consolidated Goldfields, Ltd., in the Mahdia River.

The increase in diamond production was due to the large number of miners who have returned to the diamond fields to avail themselves of the abnormally high prices now being paid, and it is anticipated that this increase will be maintained as long as the high prices prevail.

W. B.

Restrictions on Radio-active and Other Minerals.—Restrictions on the prospecting, mining, treatment and handling of radio-active minerals in the Union of South Africa, the Mandated Territory of South-West Africa, and the Gold Coast have been noted in recent issues of this BULLETIN (1945, **43**, 322-323; 1946, **44**, 154-155).

Sierra Leone has published (*Sierra Leone Royal Gazette*, May 7, 1946) a bill entitled " An Ordinance to amend the Minerals Ordinance 1927." The amendment consists of the insertion into the Minerals Ordinance of penalties for any person who, whilst engaged in mineral or prospecting operations, shall discover any of the radio-active minerals listed in an attached schedule, and who shall fail within fourteen days of such discovery to report it to the Chief Inspector of Mines. The schedule of radio-active minerals is the same as that of the Gold Coast.

Mining regulations to a similar effect have been introduced in *Fiji* as Legal Notice No. 85, in the *Supplement* to the *Fiji Royal Gazette*, April 26, 1946.

By Ordinance No. 10 of 1946 (*Uganda Gazette*, May 15, 1946), the *Uganda* Mining Ordinance (No. 29 of 1937) is amended so that a list of restricted minerals may be published and amended from time to time. On the publication of such list no prospecting licence or mining lease shall authorise the mining of, or the prospecting for, any such mineral without a special licence from the Commissioner of Mines. The discovery of any such mineral is to be reported immediately to the Commissioner.

It is worthy of note that monazite has so far been included in all the schedules attached to Colonial Empire restrictions on radio-active minerals. Monazite is a fairly ubiquitous mineral and many heavy mineral concentrates derived from alluvial detritus or crushed rocks are found to contain at least a few grains of it when examined under the microscope.

A. W. G.

BOOK REVIEWS

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

STANDARD METHODS FOR TESTING PETROLEUM AND ITS PRODUCTS. Seventh Edition. Pp. xl + 550, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: The Institute of Petroleum, 1946.) Price 15s.

The sixth edition of this book was reviewed in this BULLETIN, 1945, **43**, 246, and interest in the present edition, which resembles the previous in appearance and general make-up, is mainly in the additions and alterations to the recommended methods.

New methods are given for estimating the sulphur present as carbon disulphide in petroleum and for determining whether the coagulation of bitumen occurs on exposure of bituminous emulsions to low temperatures. The description of the procedure for determining the knock-rating of Aviation Fuel has been re-written in the light of the corresponding A.S.T.M. method.

The bromination method for the determination of tetraethyl lead in gasoline has been extensively altered. The neutralisation of the final acid solution containing lead has been facilitated by the use of *p*-nitrophenol as indicator, and time has been saved by reducing the period of digestion of the precipitated lead chromate from one hour to fifteen minutes.

In all, 21 methods have been amended to various extents. The permanency of range test has been withdrawn from the thermometer specification and replaced by a requirement that thermometers should be submitted to a suitable heat-treatment before graduation. It is no longer permissible to use thermometers manufactured according to the 1935 specification.

The Conversion Tables for Petroleum Oils have been withdrawn, while a very useful innovation is the inclusion of a list of new methods and details of revisions.

W. H. B.

CHEMISTRY OF COAL UTILIZATION. Edited by H. H. Lowry. Vol. I, pp. cv + 920; Vol. II, pp. cv + 921-1868; $8\frac{3}{4} \times 6\frac{1}{4}$. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Limited, 1945.) Price 120s.

In view of the need for a comprehensive and critical review of the literature on the chemistry of coal utilisation, the Committee on Chemical Utilization of Coal, Division of Chemistry and Chemical Technology, National Research Council, United States, decided that one should be prepared. Recognising, however, that no one person could cover the whole of the literature satisfactorily, the Committee divided the subject into 40 topics and selected a staff of 35 contributors from persons qualified to write reviews of the individual topics. The collective effort of these authors has resulted

in the production of two important volumes surveying all the writings on the subject which had been published by the end of 1939, as well as a number of later publications.

As it was thought advisable to include in the review such considerations as the origin, classification and physical properties of coals, the scope of the work is accordingly somewhat more extensive than that suggested by the title.

The first volume opens with a chapter on the origin of coal by T. A. Hendricks. This summarises all the relevant information leading to the present conceptions of the formation of normal banded coals from peat-swamp deposits, and of cannel coal from transported material. The origin of fusain is considered separately.

H. J. Rose, in Chapter 2, surveys the many methods of classifying coals, and pays special attention to recent methods of classification by type and by rank. Classification by type is also touched upon by G. H. Cady in the following chapter on coal petrography, which suffers to some extent from the extreme brevity with which the subject of preparation technique for the various methods of microscopic examination is treated. The chapter is, however, well illustrated, and the author's approval of the desirability of applying the four main terms in the Stopes nomenclature to the coals of North America is significant, as are his remarks on the over-emphasis of the botanical side of coal petrography.

A short chapter on the calorific value of coal by W. A. Selvig and F. H. Gibson gives only a brief account of methods of performing calorific value determinations, and tabulates formulæ for the calculation of calorific value from ultimate and proximate analyses.

Chapter 5, on the hardness, strength and grindability of coal, by H. F. Yancey and M. R. Geer, could have been combined with Chapter 7, in which the physical properties of coals are considered by L. C. McCabe and C. C. Boley. Chapter 6 is a 150-page account by R. E. Brewer of the plastic, agglutinating, agglomerating and swelling properties of coals; every aspect of this subject has been covered and presented in a lucid manner.

Four chapters have been devoted to the chemical constitution of coal, the authors being J. F. Weiler and H. C. Howard. They set out the modern conception of halogenation, oxidation, reduction and hydrolytic reactions.

The description in Chapter 12 of forms of sulphur in coal, by G. Thiessen, and the account by W. R. Kirner in the next chapter of the occurrence of nitrogen in coal, are complementary to those chapters in Volume II which review the compounds of these elements.

G. Thiessen's contribution on the composition and origin of the mineral matter in coal serves to introduce the following survey by E. P. Barrett of the chemical background of the fusion, flow and clinkering of coal ash; and the account of the cleaning of coal

in Chapter 16, by the authors of Chapter 5, completes this important section of the study of coal.

A. W. Gauger gives a candid criticism of moisture determination methods and shows how water is a critical variable in briquetting.

Changes in coal during storage have been surveyed successfully by L. D. Schmidt, while M. W. Kiebler sets out the present conception of the action of solvents on coal, dealing fully with the extraction of peat, brown coal and bituminous coal.

A chapter by H. C. Howard on vacuum distillation of coal is followed by one in which F. Denig provides the reader with an up-to-date knowledge of industrial carbonisation and traces, with excellent drawings, the development of the by-product oven.

There follows a short chapter by J. D. Davis, which contains considerable information in graphical and tabular form, concerning the dependence of yields of products on temperature and rate of heating. In Chapter 23, on pre-treatment of coal for carbonisation, H. H. Lowry shows the effect of pre-heating and oxidation, and M. A. Mayers concludes Volume I with a review of the physical properties and reactivity of coke.

Volume II commences with an account by A. R. Powell of the preparation and properties of coal gas. Descriptions of ovens and retorts are given, together with tables of analyses of coal gas and descriptions of specific constituents.

H. A. Gollmar deals with numerous methods of removal of sulphur compounds from coal gas, showing the distribution of sulphur throughout the gas fractions, and its recovery. The chapter is well illustrated by diagrams and photographic plates. The following long chapter by W. H. Hill concerns the recovery of ammonia, cyanogen, pyridine and other nitrogenous compounds from industrial gases.

W. L. Glowacki contributes Chapter 28, on the subject of light oil from coke-oven gas, in which are given tables showing the physical properties of the constituents of light oil and the properties of commercial light-oil distillates; graphs showing the variation of the recovery of the components of light oil with wash-oil circulation at various temperatures; and descriptions of plants for recovering light oils.

A. R. Powell discusses the removal of miscellaneous constituents from coal gas in Chapter 29; this is followed by L. Shnidman's account of the utilisation of coal gas, which includes tables and graphs connected with combustion constants, combustion calculations, limits of inflammability, explosion pressures and furnace atmospheres.

The review by E. O. Rhodes of the chemical nature of coal tar, contains, in addition to graphs, tables of analyses of tars, and a table of 348 compounds identified from the carbonisation of coal, with references to each compound.

P. J. Wilson, Jun., and J. H. Wells, in a 111-page chapter on ammoniacal liquor, review methods of analysis of ammonia and associated compounds.

Combustion has been considered in the next two chapters, the first of which, by M. A. Mayers, relates to combustion in fuel beds, and the other, by A. A. Orning, to the combustion of pulverised coal. Both chapters are well illustrated by excellent photographs and carefully prepared drawings. A short chapter by H. C. Howard follows, in which the direct generation of electricity from coal and gas is discussed.

Great credit is due to B. J. C. van der Hoeven for his treatment of the subject of producers and producer gas, and to J. J. Morgan for his review of water gas.

H. H. Storch surveys the hydrogenation of coal and tar in Chapter 38, and the synthesis of hydrocarbons from water gas in Chapter 39, where the economics of coal and carbon monoxide hydrogenation are examined. The final chapter is a review by L. L. Hirst of methanol synthesis from water gas.

Although the work has been produced under war conditions, each volume is printed on good paper, is well illustrated, and contains three indexes—a book index, a name index, and a subject index. Taken as a whole, the work gathers together into a valuable compendium the voluminous knowledge concerning coal and its utilisation which should stimulate research and bring about improvements in coal technology.

H. J. B.
P. L. R.

BIBLIOGRAPHY

Compiled by Miss J. M. Cullinan, B.A.

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the three months, May-July, 1946.

The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4 *Millbank, Westminster, S.W.*1. *Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.*

OFFICIAL ANNUAL REPORTS

Nigeria: Annual Report of the Mines Department for the year 1944. Pp. 20, 9¾ × 6¼. (Lagos: Government Printer, 1945.) Price 1*s.*

New Brunswick: 109th Annual Report of the Department of Lands and Mines of the Province of New Brunswick for the year ended 31st October, 1945. Pp. 142, 10¼ × 6¾. (Fredericton: Department of Lands and Mines, 1946.)

List of Mines, Quarries and Works [Ontario], 1941. *Ann. Rep. Ontario Dep. Mines*, 1942, **51**, Pt. 1, 49-63.

Mines of Ontario in 1941. By W. O. Tower and others. *Ann. Rep. Ontario Dep. Mines*, 1942, **51**, Pt. 1, 64-236.

Statistical Review of the Mineral Industry of Ontario for 1941. By M.

Tremblay. *Ann. Rep. Ontario Dep. Mines*, 1942, **51**, Pt. 1, 1-48, with tables showing annual gold production by mines and areas.

India: Annual Report of the Mysore Geological Department for the year 1941-42. By B. Rama Rao. *Rec. Mysore Geol. Dep.*, 1942, **41**, 1-15.

New South Wales: The State Coal Mines Control Board Thirteenth Annual Report. (Together with Balance-Sheet, Statement of Accounts and Manager's Report for the Year ended 30th June, 1945.) Pp. 3, 13½ × 8½. (Sydney: Government Printer, 1946.) Price 4*d*.

Western Australia: Report for the Department of Mines for the year 1944. Pp. 211, 13 × 8½. (Perth: Government Printer, 1945.)

Western Australia: Department of Mines. Report of the Mineralogist, Analyst and Chemist for the Year 1944. Pp. 32, 12¾ × 8½. (Perth: Government Printer, 1945.)

MINING LAW

Nigeria: The Minerals Regulations, 1946, No. 4 of 1946. Pp. 42, 10 × 7. (Lagos: Government Printer, 1946.) Price 6*d*.

Nigeria: The Safe Mining Regulations, 1946, No. 5 of 1946. Pp. 40, 10 × 7. (Lagos: Government Printer, 1946.) Price 1*s*.

Union of South Africa: Report of the Committee on Gold Mining Taxation. Pp. 20, 12¾ × 8. (Pretoria: Government Printer, 1946.) Price 1*s*. 6*d*.

COMMERCIAL INTELLIGENCE

Mining Year Book, 1946, incorporating the Mining Manual. Compiled by W. E. Skinner. Pp. 472, 8 × 5½. (London: W. E. Skinner and "Financial Times," 1946.) Price 30*s*.

Transvaal: Chamber of Mines. Reports of the Executive Committee, Gold Producers' Committee and Collieries' Committee for the year 1945. Pp. 37, 9½ × 7¼. (Johannesburg: Transvaal Chamber of Mines, 1946.)

Report on the Miscellaneous Industrial or Non-Metallic Minerals in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 31, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1946.) Price 25 cents.

Report on Miscellaneous Metals in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 38, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1946.) Price 50 cents.

The White Metal Products Industry in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 11, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1946.) Price 25 cents.

Preliminary Report on the Mineral Production of Canada, 1945. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 45, 11×8½. (Ottawa: Department of Trade and Commerce, 1946.) Price 25 cents.

Australia: Statistics Relating to Lead, Zinc, Silver, Copper and Tin for the Years 1939-1944. Pp. 6, 10¼ × 8. (Melbourne: Australian Mines and Metals Association (Incorporated), 1946.)

Annual Report of the Director of the Mint for the Fiscal Year ended June 30, 1945, including Report on the Production of Precious Metals for the Calendar Year, 1944. Pp. 97, 9¼ × 5¾. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 20 cents.

Mineral Trade Notes. *U.S. Bur. Mines*, 1946, **22**, Nos. 2, 3 and 4. Pp. 62, 45 and 49 respectively, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Illinois Mineral Industry in 1944. By W. H. Voskuil and D. F. Stevens. *Rep. Invest. No.* 109, *Illinois State Geol. Surv.* Pp. 90, 9¾ × 6¾. (Urbana, Illinois: Geological Survey Division, 1945.)

GEOLOGY AND MINERAL RESOURCES

Die Bodenschätze von Grossbritannien und Irland. *Die wichtigsten Lagerstätten der Erde, Heft* 14. Pp. 40, 9¾ × 7, and map. (Berlin: Reichsamt für Bodenforschung, 1942.) [In German.]

Die Bodenschätze des mittleren und südlichen Afrikas. *Die wichtigsten Lagerstätten der Erde, Heft* 20. Pp. 47, 9¾ × 7, and maps. (Berlin: Reichsamt für Bodenforschung, 1942.) [In German.]

Die Bodenschätze Nordamerikas (ohne Erdöl). *Die wichtigsten Lagerstätten der Erde, Heft* 15. Pp. 127, 9¾ × 7, and maps. (Berlin: Reichsamt für Bodenforschung, 1942.) [In German.]

Geology of the Maltawan-Olrig Area. By W. D. Harding. *Ann. Rep. Ontario Dep. Mines*, 1944, **53**, Pt. 6, 1-47, and maps.

Die Bodenschätze des indisch-malaiischen Raumes. *Die wichtigsten Lagerstätten der Erde, Heft* 7. Pp. 61, 9¾ × 7, and map. (Berlin: Reichsamt für Bodenforschung, 1942.) [In German.]

Die Bodenschätze des australischen Raumes. *Die wichtigsten Lagerstätten der Erde, Heft* 8. Pp. 46, 9¾ × 7, and map. (Berlin: Reichsstelle für Bodenforschung, 1941.) [In German.]

Die Bodenschätze Nordeuropas. *Die wichtigsten Lagerstätten der Erde, Heft* 13. Pp. 70, 9¾ × 7, and map. (Berlin: Reichsamt für Bodenforschung, 1942.) [In German.]

Die Bodenschätze Nordafrikas. *Die wichtigsten Lagerstätten der Erde, Heft* 19. Pp. 75, 9¾ × 7, and map. (Berlin: Reichsamt für Bodenforschung, 1942.) [In German.]

Die Bodenschätze des Nahen Ostens. *Die wichtigsten Lagerstätten der Erde, Heft* 9. Pp. 63, 9¾ × 7, and map. (Berlin: Reichsstelle für Bodenforschung, 1941.) [In German.]

Geology and Mineral Resources between Kulin and Kunghsien, South Szechuan. By Y. H. Hsiung and C. Y. Lo. *Bull. Geol. Surv. Szechuan*, 1939, No. 2, 83-150 [in Chinese, with map], 221-246 [in English].

Die Bodenschätze des asiatischen Russlands (ohne Erdöl). *Die wichtigsten Lagerstätten der Erde, Heft* 5. Pp. 68, 9¾ × 7, and maps. (Berlin: Reichsstelle für Bodenforschung, 1941.) [In German.]

PROSPECTING AND MINING METHODS

(*See also under Metals and Non-Metals.*)

Flood-Prevention Projects at Pennsylvania Anthracite Mines—A Preliminary Study. By S. H. Ash and J. Westfield. *Rep. Invest. No.* 3868, *U.S. Bur. Mines.* Pp. 25, 10½ × 8, with maps and plates. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Mine Rescue Life-Line Telephone Assemblies. By J. J. Forbes, F. E. Griffith, F. E. Cash and M. S. Petersen. *Rep. Invest. No.* 3875, *U.S. Bur. Mines.* Pp. 11, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Electronic Chronoscope for Measuring Velocities of Detonation of Explosives. By C. R. Nisewanger and F. W. Brown. *Rep. Invest. No.* 3879, *U.S. Bur. Mines.* Pp. 18, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Dust-Suppression (Pneumokoniosis) Experiments at a Kent Colliery. By F. H. Price. *Trans. Instn. Min. Engrs., Lond.*, 1946, **105**, Pt. 5, 244-267.

CONCENTRATION AND METALLURGY

(*See also under Metals and Non-Metals.*)

Crushing and Grinding Efficiencies. By T. K. Prentice. *J. Chem. Metall. Min. Soc. S. Afr.*, 1946, **46**, Nos. 7 and 8, 189-230.

Preparation and Reconditioning of Sink-float Media. By C. Y. Garber. *A.I.M.E. Tech. Pub. No.* 1985, 4 pp. *Min. Tech.*, 1946, **10**, No. 3.

METALS

Aluminium and Bauxite

Extraction of Alumina from Clays and High-Silica Bauxites. By E. P. Flint and others. *J. Res. Nat. Bur. Stand.*, 1946, **36**, No. 1, 63-106.

Bauxite Occurrences in the Bababudan Hills. By N. Panduranga Rao. *Rec. Mysore Geol. Dep.*, 1939, **38**, 116-126, and map.

Report on Prospecting for Bauxite near Shivaganga, Holalkere Taluk. By M. B. Ramachandra Rao and B. P. Radhakrishna. *Rec. Mysore Geol. Dep.*, 1939, **38**, 106-115, and maps.

Aluminum. *Rep. No.* 14, *War Changes in Industry Series, U.S. Tariff Commission.* Pp. 110, 9 × 5¾. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 25 cents.

Chromium

A Report on the Underground and Core Drill Prospecting Work of the Chromite Deposits at Byrapur. By V. T. Venugopal. *Rec. Mysore Geol. Dep.*, 1939, **38**, 73-75, and maps.

Le Chrome des Territoires d'Outre-Mer et l'Approvisionnement de la Métropole. *Bull. d' Inform., Minist. France Outre-Mer*, 1946, No. 75, 7-11. [In French.]

Exploration of Red Mountain Chromite Deposits, Kenai Peninsula, Alaska. By F. A. Rutledge. *Rep. Invest. No.* 3885, *U.S. Bur. Mines.* Pp. 26, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Cobalt

Recovery of Cobalt from Manganese Ores in the Production of Electrolytic Manganese. By D. Schlain, J. H. Jacobs, F. K. Shelton and R. G. Knickerbocker. *Rep. Invest. No.* 3866, *U.S. Bur. Mines.* Pp. 18, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Copper

Some Copper Properties in Robb, Jamieson, and Godfrey Townships. By S. A. Ferguson. *Ann. Rep. Ontario Dep. Mines*, 1944, **53**, Pt. 4, 17-29.

Der niederschlesische Zechstein und seine Kupferlagerstätte. By O. Eisentraut. *Arch. f. Lagerstättenforsch.*, *Heft* 71. Pp. 116, 9¾ × 7, and maps. (Berlin: Preussische Geologische Landesanstalt, 1939.) Price RM. 4,00. [In German.]

Gold

Die jungvulkanischen Gold-Silber-Erzlagerstätten des Karpathenbogens unter besonderer Berücksichtigung der Genesis und Paragenesis des gediegenen Goldes. By A. Helke. *Arch. f. Lagerstättenforsch.*, *Heft* 66. Pp. 175, 9¾ × 7, and plates. (Berlin: Preussische Geologische Landesanstalt, 1938.) Price RM. 8,00. [In German.]

Venezuela—the Orinoco Delta. By J. C. Davey. *Min. Mag., Lond.*, 1946, **74**, No. 6, 345-356.

Iron and Steel

The Brazeau Vanadium-bearing Magnetite Deposit, Papineau Township. By W. D. Harding. *Ann. Rep. Ontario Dep. Mines*, 1944, **53**, Pt. 6, 48-51.

The Constitution of Taranaki Ironsand. By A. D. Monro and G. Beavis. *N.Z. J. Sci. Tech.*, 1945, **27**, Sec. B., No. 3, 237-241.

Iron and Steel. *Rep. No.* 15, *War Changes in Industry Series, U.S. Tariff Commission.* Pp. 176, 9 × 5¾. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 30 cents.

Manganese and Iron Deposits of Morro do Urucum, Mato Grosso, Brazil. By J. Van N. Dorr. *Bull. No.* 946-*A*, *U.S. Geol. Surv.* Pp. 47, 9 × 5¾, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 75 cents.

Lead and Zinc

Mount Fox Lead, Kangaroo Hills. By C. C. Morton. *Queensland Govt. Min. J.*, 1946, **47**, No. 533, 77-78.

Exploration of the Big Four Zinc-Silver Mine, Summit County, Colo. By R. B. McCulloch and W. P. Huleatt. *Rep. Invest. No.* 3884, *U.S. Bur. Mines.* Pp. 7, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Exploration of Stiner and Bunch Hollow Zinc Properties, Powell River Area, Union and Clairborne Counties, Tennessee. By R. L. Sayrs. *Rep. Invest. No.* 3856, *U.S. Bur. Mines.* Pp. 4, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Examination of the Wah Wah Lead-Zinc Mine, Beaver County, Utah. By R. L. Jones and W. C. Dunham. *Rep. Invest. No.* 3853, *U.S. Bur. Mines.* Pp. 14, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Lithium

Production of Lithium Chloride from Spodumene by a Lime-Gypsum Roast Process. By W. M. Sternberg, E. T. Hayes and F. P. Williams. *Rep. Invest. No.* 3848, *U.S. Bur. Mines.* Pp. 10, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Magnesium

Examination and Treatment of Industrial Magnesium Foundry Wastes. By O. C. Garst. *Rep. Invest. No.* 3860, *U.S. Bur. Mines.* Pp. 36, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Manganese

Recovery of Cobalt from Manganese Ores in the Production of Electrolytic Manganese. By D. Schlain, J. H. Jacobs, F. K. Shelton and R. G. Knickerbocker. *Rep. Invest. No.* 3866, *U.S. Bur. Mines.* Pp. 18, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Exploration of the Piedmont Manganese Belt, McCormick County, South Carolina, and Wilkes County, Georgia. By W. A. Beck. *Rep. Invest. No.* 3858, *U.S. Bur. Mines.* Pp. 5, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Pilot-Plant Production of Electrolytic Manganese from Chamberlain, S. Dak., Nodules. By J. H. Jacobs and J. W. Hunter. *Rep. Invest. No.* 3862, *U.S. Bur. Mines.* Pp. 14, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Manganese and Iron Deposits of Morro do Urucum, Mato Grosso, Brazil. By J. Van N. Dorr. *Bull. No.* 946-*A*, *U.S. Geol. Surv.* Pp. 47, 9 × 5¾, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 75 cents.

Rare Earth Minerals

Ilmenite, Monazite and Zircon. *Prof. Pap. No.* 2, *Rec. Dep. Mineral. Ceylon*, 1944, 1-12. (Sessional Paper No. 6 of 1926 revised.)

Silver

Die jungvulkanischen Gold-Silber-Erzlagerstätten des Karpathenbogens unter besonderer Berücksichtigung der Genesis und Paragenesis des gediegenen Goldes. By A. Helke. *Arch. f. Lagerstättenforsch.*, *Heft* 66. Pp. 175, 9¾ × 7, and plates. (Berlin: Preussische Geologische Landesanstalt, 1938.) Price RM. 8,00. [In German.]

Exploration of the Big Four Zinc-Silver Mine, Summit County, Colo.

By R. B. McCulloch and W. P. Huleatt. *Rep. Invest. No.* 3884, *U.S. Bur. Mines.* Pp. 7, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Tantalum

Occurrence of Tantalite near about Batia, District Monghyr. By S. K. Chakravarty. *Quart. J. Geol. Min. Metall. Soc. India*, 1945, **17**, No. 4, 91-93.

Tin

Survey of Tin in California. By R. H. Bedford and F. T. Johnson. *Rep. Invest. No.* 3876, *U.S. Bur. Mines.* Pp. 14, 10½ × 8. (Washington: D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Titanium

Ilmenite, Monazite and Zircon. *Prof. Pap. No.* 2, *Rec. Dep. Mineral. Ceylon*, 1944, 1-12. (Sessional Paper No. 6 of 1926 revised.)

The Constitution of Taranaki Ironsand. By A. D. Monro and G. Beavis. *N.Z. J. Sci. Tech.*, 1945, **27**, Sec. B., No. 3, 237-241.

Tungsten

Mavis Bruce Wolfram Mine, Koorboora. By C. C. Morton. *Queensland Govt. Min. J.*, 1946, **47**, No. 533, 76.

Tungsten Deposits in Beaver County, Utah. By S. W. Hobbs. *Bull. No.* 945-*D*, *U.S. Geol. Surv.* Pp. 31, 9 × 5¾, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 65 cents.

Exploration of the Mecklenburg County, Va. Tungsten Area. By B. E. Argyle. *Rep. Invest. No.* 3857, *U.S. Bur. Mines.* Pp. 5, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Vanadium

The Brazeau Vanadium-bearing Magnetite Deposit, Papineau Township. By W. D. Harding. *Ann. Rep. Ontario Dep. Mines*, 1944, **53**, Pt. 6, 48-51.

The Constitution of Taranaki Ironsand. By A. D. Monro and G. Beavis. *N.Z. J. Sci. Tech.*, 1945, **27**, Sec. B., No. 3, 237-241.

NON-METALS

Asbestos

Prospecting for Asbestos in the Holenarsipur Taluk (Hassan District). By T. P. Krishnachar. *Rec. Mysore Geol. Dep.*, 1939, **38**, 93-105, and map.

Chrysotile Asbestos Deposits, Flora Survey District, North-West Nelson [N.Z.]. By W. E. Hall and J. J. Reed. *N.Z. J. Sci. Tech.*, 1945, **27**, Sec. B., No. 3, 177-184.

Barytes

Barium Minerals in England and Wales. By K. C. Dunham, H. G. Dines and others. *Wartime Pamphlet No.* 46, *Geol. Surv. Great Britain.* Pp. 150, 12¾ × 8. (London: Geological Survey and Museum, 1945.) Price 6*s.* 9*d.*

Building Materials

The Sand and Gravel Industry in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 9, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1946.) Price 25 cents.

The Sand-Lime Brick Industry [in Canada], 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 4, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1946.) Price 10 cents.

China Clay

Report of the Working Committee on China Clay. *Board of Trade.* Pp. 14, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 3*d.*

Clay and Ceramics

The Bonding Action of Clays. Part II—Clays in Dry Molding Sands. By R. E. Grim and F. Leicester Cuthbert. *Rep. Invest. No.* 110, *Illinois State Geol. Surv.* Pp. 36, 9¾ × 6¾. (Urbana, Illinois: Geological Survey Division, 1946.)

Amenability of Various Types of Clay Minerals to Alumina Extraction by the Lime Sinter and Lime-Soda Sinter Processes. By R. E. Grim, J. S. Machin and W. F. Bradley. *Bull. No.* 69, *Illinois State Geol. Surv.* Pp. 77, 9¾ × 6¾. (Urbana, Illinois: Geological Survey Division, 1945.)

The Clay and Clay Products Industry in Canada, 1944 (including: 1. Products from Domestic Clays; 2. Products from Imported Clays). *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 23, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1946.) Price 25 cents.

Coal, etc.

Chemistry of Coal Utilization. Edited by H. H. Lowry. Vol. I, pp. cv + 920; Vol. II, pp. cv + 921-1868, 8¾ × 6¾. (New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Limited, 1945.) Price 120*s.*

United Kingdom: Report of the Coal Commission for the year ended 31st March, 1945. *Ministry of Fuel and Power.* Pp. 8, 9½ × 6. (London: H.M. Stationery Office, 1945.) Price 2*d.*

Bristol and Somerset Coalfield Regional Survey Report. *Ministry of Fuel and Power.* Pp. 84, 9½ × 6, and map. (London: H.M. Stationery Office, 1946.) Price 1*s.* 6*d.*

Coal Tar and its Derivatives—Part II. By-Product Recovery from Coal Tars in India. By C. J. Fielder. *J. Sci. Industr. Res., India*, 1946, **4**, No. 9, 528-539. Contribution to the *Dictionary of Economic Products and Industrial Resources of India.*

Coal Resources of the Kawakawa-Waiomio Area, North Auckland. By J. Healy. *N.Z. J. Sci. Tech.*, 1945, **27**, Sec. B., No. 3, 224-236.

Takaka Coalfield [N.Z.]. By H. W. Wellman. *N.Z. J. Sci. Tech.*, 1945, **27**, Sec. B., No. 3, 189-198.

Die ostasturischen Steinkohlenbecken. By H. Quiring. *Arch. f. Lagerstättenforsch., Heft* 69. Pp. 66, 9¾ × 7, with maps and plates. (Berlin: Preussische Geologische Landesanstalt, 1939.) Price RM. 3,00. [In German.]

Inspection Standards for Strip Mines (Coal and Lignite)—Revised October, 1945. *Inform. Circ. No.* 7350, *U.S. Bur. Mines.* Pp. 32, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Annual Report of Research and Technologic Work on Coal. Fiscal Year 1945. By A. C. Fieldner and R. E. Brewer. *Inform. Circ. No.* 7352, *U.S. Bur. Mines.* Pp. 103, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Fluorspar

Exploration of Gallinas Fluorspar Deposits, Lincoln County, N. Mex. By J. H. Soulé. *Rep. Invest. No.* 3854, *U.S. Bur. Mines.* Pp. 25, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Exploration of the Bear Lodge Fluorite Property, Crook County, Wyo. By W. C. Dunham. *Rep. Invest. No.* 3877, *U.S. Bur. Mines.* Pp. 7, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Gemstones

Gems and Semi-Precious Stones of Ceylon. By D. N. Wadia and L. J. D. Fernando. *Prof. Pap. No. 2, Rec. Dep. Mineral. Ceylon*, 1944, 13-44, and maps.

Glass

Investigation of the McLeod Glass-Sand Pits, Wheeler County, Ga. By W. C. Hudson. *Rep. Invest. No.* 3859, *U.S. Bur. Mines.* Pp. 3, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Helium

The Properties and Uses of Helium (including a Comprehensive Bibliography, 1933-45). By H. P. Wheeler, Jr. *Inform. Circ. No.* 7344, *U.S. Bur. Mines.* Pp. 66, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Lime and Limestone

Limestone at Motatau [N.Z.]. By J. Healy. *N.Z. J. Sci. Tech.*, 1945, **27**, Sec. B, No. 3, 185-188.

Petroleum, etc.

International Petroleum Trade. *Int. Petrol. Tr.*, **15**, Nos. 1, 2, 3, 4 and 5. *U.S. Bur. Mines.* Pp. 22, 14, 10, 16 and 13 respectively, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Standard Methods for Testing Petroleum and its Products. Seventh Edition. Pp. xl + 550, 8½ × 5½. (London: The Institute of Petroleum, 1946.) Price 15*s*.

Recovery and Utilization of Oil from Oil-Field Waste Emulsion. By J. W. Horne, J. Wade Watkins and A. Matzick. *Rep. Invest. No.* 3869, *U.S. Bur. Mines.* Pp. 16, 10½ × 8, and plates. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Extinction of Gasoline Flames by Inert Gases. By G. W. Jones and W. R. Gilland. *Rep. Invest. No.* 3871, *U.S. Bur. Mines.* Pp. 14, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

The Natural Gas Industry in Canada, 1944. *Min. Metall. Chem. Br., Dom. Bur. Stats.* Pp. 11, 11 × 8½. (Ottawa: Department of Trade and Commerce, 1946.) Price 25 cents.

Erdöl in Europa und im nahen Orient. *Die wichtigsten Lagerstätten der Erde, Heft* 2. Pp. 30, 9¾ × 7, and maps. (Berlin: Reichsstelle für Bodenforschung, 1940.) [In German.]

Die Erdöl-Lagerstätte im Forstort Brand bei Nienhagen (Hannover). By F.-E. Klinger. *Arch. f. Lagerstättenforsch., Heft* 70. Pp. 53, 9¾ × 7, and map. (Berlin: Preussische Geologische Landesanstalt, 1939.) Price RM. 3,00. [In German.]

Erdöl in Russland. *Die wichtigsten Lagerstätten der Erde, Heft* 4. Pp. 56, 9¾ × 7, and maps. (Berlin: Reichsstelle für Bodenforschung, 1941.) [In German.]

Erdöl in Südamerika. *Die wichtigsten Lagerstätten der Erde, Heft* 18. Pp. 61, 9¾ × 7, and maps. (Berlin: Reichsamt für Bodenforschung, 1942.) [In German.]

Guatemala's Proposed Oil Law. By R. Sheldon. *World Petrol.*, 1946, **17**, No. 5, 47-49, 89.

Venezuela—the Orinoco Delta. By J. C. Davey. *Min. Mag., Lond.*, 1946, **74**, No. 6, 345-356.

Erdöl in Vorderasien. *Die wichtigsten Lagerstätten der Erde, Heft* 21.

Pp. 64, 9¾ × 7, and map. (Berlin: Reichsamt für Bodenforschung, 1942.) [In German.]

Phosphates

Production of Silicophosphate. *Memo. No. RB (NS) 17, E. Afr. Industr. Res. Bd.* Pp. 3, 13 × 8¼. (Nairobi: East African Industrial Research Board, 1946.)

The Marketing of Silicophosphate in the Union. *Memo. No. RB (NS) 18, E. Afr. Industr. Res. Bd.* Pp. 2, 13 × 8¼. (Nairobi: East African Industrial Research Board, 1946.)

Les Phosphates Marocains—Étude Technique, Commerciale et Sociale. *Bull. Econ. et Soc. Maroc*, 1945, **7**, No. 27, 108-123. [In French.]

Potash

Diamond Drilling of Potash Reserves in Eddy County, N. Mex. By W. R. Storms. *Rep. Invest. No.* 3861, *U.S. Bur. Mines.* Pp. 11, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Quartz

Piezo-Electric Quartz in Tanganyika. By B. N. Temperley. Pp. 14, 9¾ × 6¾. Reprinted from *Tanganyika Notes and Records*, No. 19, June, 1945.

Refractories

Aluminous Refractories in the Mysore District. By T. P. Krishnachar. *Rec. Mysore Geol. Dep.*, 1939, **38**, 84-92, and map.

Salt

Die Salzlagerstätten des deutschen Zechsteins—Ein Beitrag zur Entstehung ozeaner Salzablagerungen. By H. Borchert. *Arch. f. Lagerstättenforsch., Heft* 67. Pp. 196, 9¾ × 7, and plates. (Berlin: Reichsstelle für Bodenforschung, 1940.) [In German.]

Silica Sand

Deposits of Silica in the Neighbourhood of Bhadravati, Shimoga District. By B. Lakshmana Rao. *Rec. Mysore Geol. Dep.*, 1939, **38**, 76-83, and map.

Investigation of the Miami-West Palm Beach Belt of Silica Sand in Florida. By W. C. Hudson. *Rep. Invest. No.* 3865, *U.S. Bur. Mines.* Pp. 5, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Vermiculite

Vermiculite—A Modern Insulation and Constructional Material. By N. Clarke Jones. *Chem. and Industr.*, 1946, No. 20, 195-196.

Water Supply

Ground-Water Resources of the El Paso Area, Texas. By A. N. Sayre and P. Livingstone. *Water-Supply Paper No.* 919, *U.S. Geol. Surv.* Pp. 190, 9 × 5¾, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

Zircon

Ilmenite, Monazite and Zircon. *Prof. Pap. No. 2, Rec. Dep. Mineral. Ceylon*, 1944, 1-12. (Sessional Paper No. 6 of 1926 revised.)

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PLANT AND ANIMAL PRODUCTS

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the Reports made to the Dominion, Indian and Colonial Governments

BLACK PEPPER FROM SIERRA LEONE

By H. T. Islip, B.Sc., F.R.I.C., and F. Major, B.Sc., A.R.I.C.

A sample of black pepper (*Piper nigrum*) received from the Director of Agriculture, Sierra Leone, in 1944, although having the appearance of good quality peppercorns, was found on examination at the Imperial Institute to be rather abnormal in composition, the amounts of some of the constituents being outside the range of figures previously recorded for black pepper (see this Bulletin, 1945, **43**, 6).

In view of the difference in composition of this sample in comparison with that of black pepper from other sources, it was thought desirable to obtain additional samples from Sierra Leone, in order to ascertain whether this difference was characteristic of the Sierra Leone product. Further samples were received in 1945 and 1946 and the results of examination of these later samples are now published in order that authoritative figures for the composition of black pepper from Sierra Leone may be generally available.

It is necessary to realise, however, that although from the examination of the samples it would appear that Sierra Leone black pepper is abnormal in composition, no information is available at present concerning the reason for this abnormality. This may have been caused by a difference in the plant itself, or by climatic and soil conditions and manurial treatment in Sierra Leone.

Particulars and Description of Samples

1945 *Samples* (Received May 29, 1945).

Sample A.—Fully mature berries, steeped in boiling water for ten minutes and then dried in the sun.

The sample consisted of small spherical seeds, 3-6 mm. diameter, the majority having a smooth outer covering and varying in colour from pale brown to almost black. A small amount of loose skin was present. The colour of the seeds themselves was a pale greyish-buff.

Average weight of 100 peppercorns—7·2 gm.

Sample B.—Berries harvested when one or two berries at the base of the spike were beginning to turn red, i.e. semi-ripe berries. Sun-dried only.

Small spherical seeds, 4-5 mm. in diameter, with a wrinkled surface and varying in colour from brown to almost black.

Average weight of 100 peppercorns—6·4 gm.

1946 *Samples* (Received July 2, 1946).

Sample No. 1.—Semi-ripe, sun-dried berries.

Peppercorns wrinkled in appearance and varying in colour from pale brown to almost black; the majority of the peppercorns were approximately 4-5 mm. in diameter, but there were a number of very shrivelled seeds present in the sample. A very small amount of vegetable débris (small pieces of stem and husk) was also present.

Average weight of 100 peppercorns—4·9 gm.

Sample No. 2.—Semi-ripe berries, steeped in boiling water for ten minutes and then sun-dried.

Peppercorns, the majority of which were wrinkled in appearance, varying in colour from pale brown to almost black. There were also present in the sample a number of peppercorns having a smooth surface and these varied in colour from reddish-brown to almost black. As in the case of Sample No. 1, several very shrivelled peppercorns were present. The diameter of the majority of the peppercorns was 4-5 mm.

Average weight of 100 peppercorns—5·1 gm.

Sample No. 3.—Ripe, sun-dried berries.

Peppercorns much wrinkled in appearance, varying in colour from pale brown to black, the majority having a diameter of 4-5 mm. There were, however, a number of very small peppercorns present in the sample which tended to make the sample very uneven in appearance.

Average weight of 100 peppercorns—4·1 gm.

Sample No. 4.—Ripe berries, steeped in boiling water for ten minutes and then sun-dried.

Peppercorns 4-5 mm. in diameter, some being wrinkled while others were smooth externally. The former varied in colour from pale to dark brown, whereas those having a smooth outer surface varied from light reddish-brown to almost black. As in the other three samples received in 1946 there were many very small immature seeds present; these were, without exception, pale brown in colour.

Average weight of 100 peppercorns—4·5 gm.

The average weight of 100 peppercorns recorded above for each of the last four samples must be regarded as approximate, owing to

the difficulty in selecting representative lots of 100 peppercorns from material of such mixed sizes.

Results of Examination

The results of the chemical examination of the foregoing six samples of black pepper from Sierra Leone are shown in the table on page 278 in comparison with those of the sample received in 1944, with the ranges of corresponding recorded figures for black pepper and with the U.S.A. and Australian standards.

Remarks

The results of the chemical examination show the composition of the present samples of black pepper from Sierra Leone to be generally similar to that of the previous sample. There are minor differences between the individual samples but these would appear to be of little importance.

The sample received in 1944 had been harvested, as is customary with black pepper, before the berries were fully ripe. Comparing this sample and the other samples of unripe berries (Samples B, No.1 and No. 2) with the ripe berries (Samples A, No. 3 and No. 4) it will be observed, from the table of results, that there are no significant differences in composition as between the unripe and ripe berries. Thus the unusual constants obtained at the Imperial Institute are not due to the stage of ripeness of the pepper.

Like the first sample examined, all the present samples contained considerably less piperine than that recorded for black pepper; as regards the non-volatile ether extract and starch content, however, which were both outside the range of figures previously recorded for black pepper, there are slight differences between the samples examined in 1945 and 1946. In the case of the 1945 samples, the non-volatile ether extract just reached the lower limit of recorded results and was in accordance with the Australian Standard (but still below the U.S.A. Standard) though the starch content was in excess of the maximum recorded for this constituent, whereas with the 1946 samples, the non-volatile ether extract was again below the minimum previously recorded (though higher than was the case with the 1944 sample) and the starch content, unlike the three earlier samples, was just within the range of recorded results.

Although there is very little difference in composition as between the semi-ripe and ripe berries receiving similar treatment, there are indications that the two treatments, i.e. merely sun-drying or steeping in boiling water before sun-drying, produce peppers of slightly differing composition. In the case of the 1946 samples, the piperine content is appreciably higher in both samples of steeped berries (Samples No. 2 and No. 4), whilst there is a tendency for the amounts of crude fibre and protein to be lower than in the samples which were not steeped. On the other hand, with the 1945 samples the reverse is the case as regards the piperine content, which was

COMPOSITION OF BLACK PEPPER FROM SIERRA LEONE

	Present samples. Received in 1945.		Present samples. Received in 1946.				Previous sample received in 1944*.	Range of recorded figures for Black Pepper.	U.S.A. Standard.	Australian Standard.
	Sample A	Sample B	Sample No. 1.	Sample No. 2	Sample No. 3.	Sample No. 4.				
Conditions when harvested.	Ripe.	Semi-ripe.	Semi-ripe.	Semi-ripe.	Ripe.	Ripe.	Semi-ripe.			
	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.	per cent.
Moisture†	14·2	12·7	12·2	12·6	12·6	12·3	12·1	7·5 – 12·95	—	—
Ash, total	‡	‡	3·8	3·6	3·8	3·5	3·7	2·75 – 9·32	Not more than 7·0	Not more than 7·0
Ash, insoluble in HCl	‡	‡	0·04	0·06	0·05	0·04	0·06	0·00 – 1·63	Not more than 1·5	—
Ether extract: Volatile at 110° C.	0·55	0·7	1·0	0·7	1·1	1·2	1·1	0·5 – 3·85	—	—
Ether extract: Non-volatile	6·1	6·1	5·8	5·9	5·9	5·8	5·5	6·10 – 9·64	Not less than 6·75	Not less than 6·0§
Starch, by acid hydrolysis	44·5	46·8	43·2	43·2	40·0	42·2	44·7	28·0 – 43·47	Not less than 30	—
Crude fibre	‡	‡	10·9	9·5	10·5	9·9	9·6	8·0 – 18·25	—	—
Crude Proteins‖	‡	‡	10·0	9·7	10·2	9·9	9·7	7·0 – 21·91	—	—
Piperine¶	2·85	3·07	2·59	3·06	2·62	2·80	2·95	4·89 – 9·78	—	—

* *See this* BULLETIN, 1945, **43**, 6.
† *Matter volatile at* 110° *C.*
‡ *Insufficient of sample to permit of these determinations being made.*
§ *Not less than* 8·0 *per cent. non-volatile alcohol extract.*
‖ (*Total nitrogen less nitrogen in fixed oil*) × 6·25.
¶ *Nitrogen in non-volatile ether extract* × 20·36.

higher in unsteeped sample B. (The amounts of these two samples were insufficient to allow of the content of crude fibre and protein being determined). Regarding the 1945 samples, however, it is questionable whether the comparison between the two treatments is strictly valid, since the two samples (representing ripe and semi-ripe berries) were harvested at different times and did not consist of the same material treated in two different ways as, presumably, was the case with the 1946 samples.

The average weight of the seeds in each of the four samples received in 1946, particularly the ripe seeds, was considerably lower than that of the seeds of the previous three samples. This was brought about by the presence in these samples of an undesirable number of very small, shrivelled peppercorns, which detracted considerably from the appearance of the samples and reduced their market value in comparison with the earlier samples.

It would appear that a low piperine content, a rather low non-volatile ether extract and a somewhat high percentage of starch, are characteristic of the present growth of pepper in Sierra Leone. The relatively small amounts of piperine found in the seven samples of Sierra Leone black pepper so far examined at the Imperial Institute is the outstanding difference between this pepper and that from other sources. Whether the difference in piperine content is due to the plant itself or climatic and soil conditions in Sierra Leone cannot be stated, but it would seem desirable to establish the point by trial cultivation of *Piper nigrum* of normal composition imported into Sierra Leone for this purpose.

Although material as represented by the seven samples of black pepper might be acceptable in the United Kingdom during the present shortage of this commodity, and whilst the Ministry of Food is the sole importer of the product, there is the possibility, when supplies are again normal, that pepper having unusual constants would suffer in competition with pepper of the recognised composition. It is suggested, therefore, that if the cultivation of pepper as an export crop is to be given further consideration, attention should be paid to overcoming, if possible, the undesirable analytical features of the present product. In this connection, cultivation experiments to improve the present growth or trials with new imported material, as already mentioned, may lead to an alteration in the constants in question.

PAPYRUS FROM PALESTINE

By G. E. Barkworth, B.Sc., A.R.I.C., and H. E. Coomber, B.Sc.

The utilisation of the stems of papyrus (*Cyperus papyrus*, a major constituent of the Nile "sudd") is a perennial question which has been the subject of considerable experimental and technical investigation to test the value of the material as a source of cellulose pulp for paper-making. The Imperial Institute has previously

examined samples of the material from East Africa, Northern Rhodesia, Zululand, Egypt and the Anglo-Egyptian Sudan and technical work has been carried out in the Belgian Congo, in France and in this country.

The earlier work at this Institute indicated that papyrus stems yielded a pulp which could be converted into a fairly good paper, but that they contained a large percentage of pithy matter which would be costly to remove and which would necessitate a somewhat high consumption of soda in the digesters; while the resulting paper was inclined to be "rattly." It was found possible in the laboratory experiments to remove a considerable proportion of the pithy matter, but this operation reduced the yield without greatly improving the quality of the pulp.

Material from the Sudan examined in 1930, however, gave greatly improved results owing to the fact that the papyrus stems contained less pith than in the material examined earlier. The paper prepared was obtained by the soda process and produced a well-digested pulp which furnished a fairly hard, rather bulky, opaque pale-brown paper, of excellent strength and quality. The pulp bleached readily, producing a white paper similar in character and strength to that prepared from the unbleached pulp. The yield of unbleached pulp was 43 per cent. and the yield of bleached pulp 39 per cent.

Manufacturers in this country have also carried out experiments with papyrus and have recognised the value of removing the pith from the stems and using only the relatively tough outer tissues which gave good technical results. Similar work has been carried out in France, where promising results were also obtained. No permanent commercial developments appear to have taken place, however, either in this country or abroad, other than the running of a factory in Uganda for making board.

The Imperial Institute had occasion to look into the question in 1939 arising out of press reports of possible exploitation of the papyrus of French Equatorial Africa, when it was learned on official French authority that plans which had been made some years previously to exploit the material had been abandoned as they did not offer commercial interest.

The position would appear to be that papyrus stems containing comparatively restricted pith, or mechanically deprived of the pith, form an excellent source of pulp for certain classes of paper, but the factor limiting the commercial exploitation of the material, in normal times, is that of competition as to cost (and high technical value) of wood pulps from Scandinavia and elsewhere.

A further sample of papyrus was received at the Imperial Institute in 1944 from Palestine and an investigation of this material was carried out at the request of the Department of Overseas Trade in order to ascertain its value as a raw material for paper and board making. The results of this investigation are given below.

Results of Examination

The sample consisted of two bales, each weighing about 100 lb., of reeds having the normal appearance of papyrus, and cut into lengths of about 36 in. They were roughly triangular in cross section, from 0·4 to 2·1 in. broad, mainly about 1 in., and they varied in thickness from 0·3 to 1·2 in., being mainly about 0·75 in. thick. Externally the reeds varied in colour from brownish-cream to dark brown; internally they were light buff to brown, mostly buff. There was a considerable amount of pithy matter present.

A representative portion of the reeds was cut up into pieces of about ¾ to 1 in. in length and examined as described below.

Moisture in the material as received: 11·8 per cent.

Microscopical examination of the ultimate fibres: Ultimate fibres were prepared and examined microscopically. The dimensions of the fibres, measured by means of the projection microscope, were as follows:

	Maximum. *mm.*	Minimum. *mm.*	Average. *mm.*
Length . .	6·25	0·36	1·62
Width . .	0·019	0·0063	0·011

The ultimate fibres were narrow, with tapering ends and narrow lumens. Some parenchymatous cells were present.

It will be seen from the above figures that the present sample is fairly short-fibred material from the paper-making point of view.

Paper-Making Trials

In view of its short fibre length the utilisation of this material in paper manufacture would probably be restricted to the soda process. In consequence, laboratory paper-making trials were confined to this process.

The chopped papyrus was cooked in a rotary digester under conditions approximating to those employed commercially for the production of pulp by the soda process. The cooking conditions employed and the yields of unbleached pulp obtained are given in Table I:

Table I

Digestion No.	Maximum temperature.	Time at maximum temperature.	Strength of caustic soda solution.	Parts of caustic soda used per 100 parts of moisture-free reeds.	Parts of caustic soda consumed per 100 parts of moisture-free reeds.	Yield of unbleached moisture-free pulp on moisture-free reeds.
	° C.	*hours.*	*per cent.*			*per cent.*
N 102 .	140	3	3·0	15·0	12·0	44·3
N 103 .	130	3	2·0	17·0	12·6	45·7
N 105 .	140	6	3·0	25·0	16·3	38·8
N 108 .	130	4	1·0	15·0	11·8	49·8

The reeds were found to be readily pulped by the soda process

under relatively mild conditions, but some difficulty was experienced in obtaining a pulp sufficiently free from shive.

The yield obtained under the very mild conditions of cook N 108 reached 49·8 per cent. of moisture-free pulp expressed on the weight of moisture-free material, but the pulp so obtained contained a very considerable amount of shive. Cook N 105, on the other hand, yielded a pulp reasonably free from shive, but the yield was reduced to 38·8 per cent. The best pulp was obtained under the conditions of boil N 102 with a yield of 44·3 per cent., the shive content being only slightly more than that of the pulp produced in cook N 105.

Pulp Evaluation.—In order to evaluate the strength and general quality of the pulps obtained in the cooking trials, standard sheets were prepared by means of the British Standard Sheet Machine, using the official method described in the Second Report of the Pulp Evaluation Committee of the Paper Makers' Association. The sheets were dried and conditioned overnight at 70°F. and 65 per cent. relative humidity prior to testing, which was carried out according to the official method of The Paper Makers' Association. The results of the tests on the standard sheets are given in Table II below:

TABLE II

Digestion No.	N 102	N 103	N 105	N 108
Basic weight *g./sq. metres*	59·24	60·84	58·68	57·80
Thickness *microns*	106·0	103·0	98·5	117·0
Bulk *cc./gram*	1·789	1·692	1·679	2·024
Burst Factor *g./sq. cm.*	43·26	38·06	31·92	30·77
Breaking Length *metres*	8,013	6,898	5,425	6,306
Stretch *per cent.*	3·17	2·87	3·44	2·09
Tear Factor *g.*	23·21	23·42	20·45	30·42
Drainage Time *seconds*	10·25	7·8	6·0	8·3
Remarks . .	Rather shivy. Brown colour. Well-formed sheets, somewhat pitted. Rattly.	Rather more shivy than 102. Brown colour. Well formed smooth sheets. Rattly.	Almost clean. Pale brown colour. Well formed smooth sheets. Less rattly than 102 and 103.	Brown colour. Rather rough sheets with long fibres visible. Sheets well formed.

The pulp evaluation figures show that the pulps, prepared from the present sample, yield papers which give a satisfactory breaking length and a medium burst factor, but a low tear factor. The figures obtained for the unbeaten pulps indicate that paper prepared from the present material will have the defect of a low tearing strength. This would not be improved by beating.

Board-Making Trials

(*a*) *Paper Board*

For these trials some of the pulps prepared in the paper-making trials were employed, and in addition further pulps were specially prepared. The soda digestion method was used, as in the paper-making experiments, and in addition an open-pan digestion was carried out.

The cooking conditions employed for the additional pulps and the yields of unbleached pulps obtained are given in Table III.

Table III

Digestion No.	Maximum temperature.	Time at maximum temperature.	Strength of caustic soda solution.	Parts of caustic soda used per 100 parts of moisture-free reeds.	Parts of caustic soda consumed per 100 parts of moisture-free reeds.	Yield of unbleached moisture-free pulp on moisture-free reeds.
	° C.	*hours.*	*per cent.*			*per cent.*
N 106 .	140	6	Water only used			53·9
N 107 .	140	6	0·72	10·8	9·8	50·6

One pulp (Boil No. B 1) was prepared in an open pan under the following conditions :—

Boil No.	Duration of boil.	Strength of caustic soda solution.	Parts of caustic soda used per 100 parts of moisture-free reeds.	Parts of caustic soda consumed per 100 parts of moisture-free reeds.	Yield of unbleached moisture-free pulp on moisture-free reeds.
	hours.	*per cent.*			*per cent.*
B 1 . .	3	0·5	13·3	10·9	65·4

Boards were prepared from the pulps, in some of which china clay in varying proportion was incorporated. Their composition is shown in Table IV. They were made on a couch. After removal from the couch, the sheets received a light pressing between two sheets of copper gauze in order to remove excess water, after which they were dried under a pressure of approximately 200 lb./sq. in., between plattens heated to 100°C.

Table IV

Board No.	Weight of pulp (moisture-free).	Weight of china clay.	Ratio : pulp/china clay.
	grams.	*grams.*	
N 107 . . .	75	—	—
N 106 . . .	100	—	—
N 108 . . .	100	25	80/20
N 103/105 equal quantities	100	100	50/50
B 1 (A) . .	100	—	—
B 1 (B) . .	80	20	80/20

The prepared boards had the following characteristics :—

Board No.

N 107.—This pulp gave a firm, flexible board of a light brown colour. It had a fine texture and a smooth surface.

N 106.—The board from this pulp was firm, fairly flexible and of a dark brown colour, with a rougher surface and more bulk than N 107. It had a medium texture with a rather rough surface.

N 108.—This pulp gave a firm, flexible, fawn-coloured board of a fairly fine texture and a smooth surface. Its bulk was similar to N 106.

N 103/105.—This pulp gave a firm, fairly flexible, pale fawn-coloured board, less flexible than N 106. It had a smooth surface and a fine texture, but was somewhat overloaded with filler.

B 1 (A).—This pulp gave a firm, flexible, light-brown coloured board similar to N 107.

B 1 (B).—This pulp gave a firm, flexible, fawn-coloured board, less flexible than B 1 (A), but similar in other respects.

All the above boards were of fairly high density.

(*a*) *Building-board*

Pulps for building-board trials were prepared, the method employed being different from that used for the paper-board pulps. The papyrus was cut up into pieces of about 1 in. in length and passed through a disintegrator running at approximately 3,000 r.p.m. and fitted with a screen having ¼ in. diameter apertures. This yielded a product consisting of fibrous material, broken down into narrow strips from ¾ to 1 in. long and pith, broken down into small or very small fragments.

This material was treated in an open pan under the conditions given below in Table V :—

TABLE V

Boil No.	Material boiled with water.	Duration of boil.
B.B.1	Water only	2 hours
B.B.2	Water+2 per cent. calcium hydroxide calculated on the weight of air-dry material taken	1 hour

After treatment the pulps were well washed and boards were prepared on the same couch as that used for the paper-boards. After removal from the couch the boards received a light pressing between two sheets of copper gauze in order to remove excess water. The boards were then dried at 100°C. between plattens fitted with spacing bars so that although the boards were formed under pressure the pressure was restricted to that necessary to reduce the boards to the thickness of the spacing bars.

The prepared boards had the following characteristics :—

*Board prepared from boil No. B.B.*1.

—A low density board of good appearance, light reddish-brown in colour. Fairly firm and rigid, with no signs of warping.

*Board prepared from boil No. B.B.*2.

—A low density board of good appearance, slightly darker than B.B.1. Firm and rigid with no signs of warping.

Conclusions

(1) *Paper Pulp.*

This investigation has shown that the present sample of papyrus is reduced to a satisfactory paper pulp under fairly mild conditions of digestion and that under the conditions required to produce a satisfactory pulp, relatively free from shive, a yield of 44 per cent. of moisture-free pulp expressed on the moisture-free reeds is obtained. This may be regarded as moderately satisfactory for this type of material. Paper prepared from the pulps, however, lacked tearing strength and this factor would greatly restrict the use of this material in paper making.

(2) *Paper-board Pulp.*

The trials have shown that the material can be readily pulped for the production of a paper pulp which can be formed into high-quality board. The boards prepared in the six trials all showed good strength, density and flexibility. The yields of pulp were satisfactorily high, particularly in Trial B 1, where a very dilute caustic soda solution was employed in an open-pan digestion. This latter trial indicates a method of production involving low costs.

(3) *Building-board Pulp.*

In these trials it was found that the material could be reduced to the condition required for building board by very mild treatment and the pulp obtained could be readily formed into a thick, loosely-compacted board suitable for heat and sound insulation. It held together well without the aid of binder and was generally of good quality and attractive appearance.

Remarks

The present examination of papyrus from Palestine was undertaken chiefly with a view to ascertaining the suitability of the material for making fibre board. The properties of papyrus as a raw material for paper-pulp manufacture had, as already stated, been investigated on many previous occasions at the Imperial Institute with representative samples from East Africa, Northern Rhodesia, Zululand, Egypt and the Sudan. It had been established that papyrus stems are capable of yielding a pulp of fairly good quality

for certain purposes and that an improved pulp resulted from the removal of the pithy matter in the preparation, a step which, however, added considerably to the manufacturing costs. The factor which has limited the commercial exploitation of this material is that of costs in competition with the wood pulps already on the world market.

Further it is understood that the papyrus available in Palestine is estimated at roughly 26,000 tons annually from the Huleh Valley. This quantity represents about 9,000 tons of air-dry material. For a paper-pulp mill to run economically the annual output should be at least 10,000 tons of finished pulp and for this reason alone the Palestine resources are insufficient for running a paper pulp industry either for local use or for export. The prospects of using the papyrus for the production of fibre board are, however, more promising and worth consideration, since the annual quantity of papyrus available, although not permitting the establishment of an industry for export trade, is sufficient for a production to supply the local market, since a unit of plant producing 2,500 tons of board a year can be profitably run.

In this investigation the papyrus stems from Palestine have yielded results as a paper-making material which are in line generally with those previously obtained at the Imperial Institute on this material from other countries, and although the examination of the present sample has not been carried beyond the preliminary stage the results indicate that the factors governing the utilisation of Palestine papyrus as a raw material for paper pulp production are the same as for papyrus from other sources.

The application of Palestine papyrus for the manufacture of a compressed board for cartons and containers, or a board for building purposes, including heat and sound insulation, is worth further consideration as a small industry to supply local needs. The present sample of papyrus has yielded promising results as a board-making material, but as the next stage in the investigation it would be desirable to prepare larger boards on a commercial or pilot plant, and study their physical properties, subjecting them to mechanical strength tests. From these results it would be possible to decide on the most suitable type of board to produce, the best method of manufacture to employ and the economics involved.

It must be borne in mind that the papyrus available in Palestine according to the estimated possible annual yield, is only sufficient for an industry on very modest lines to be contemplated, and ultimately the deciding factor will be the cost of local production as compared with the cost of importing the mass-produced article from overseas.

CINNAMON LEAF OIL FROM SEYCHELLES

By D. J. Cosgrove, B.Sc., A.R.I.C., and H. T. Islip, B.Sc., F.R.I.C.

The production of cinnamon leaf oil is of considerable importance to Seychelles, the output in 1939 having been about 67 tons. Nearly the whole of this quantity was exported to the United States of America, where it was used mainly for the production of vanillin. The cinnamon leaf oil consumed in the United Kingdom is chiefly of Ceylon origin and finds a use mainly as a perfume in soap manufacture. The Ceylon oil is preferred for this purpose as its odour is considered more desirable than that of the Seychelles oil, which consequently commands a lower price.

It was thought that the different odour of the Seychelles oil might be due to the oil's containing a higher percentage of eugenol, the presence of which is responsible for the "clovey" odour. Accordingly, the following investigation was carried out at the Government Central Distillery, Mahé, to determine whether it was possible to obtain from the Seychelles oil by fractional steam distillation a fraction, or mixture of fractions, more closely resembling the Ceylon product.

About 13 litres of Seychelles cinnamon leaf oil were fractionally distilled, the fractions being collected at 30 minutes' intervals during the distillation. The respective volumes of the ten fractions obtained were:

	ml.
1st Fraction	2,400
2nd "	2,500
3rd "	2,400
4th "	1,400
5th "	1,330
6th "	800
7th "	600
8th "	610
9th "	360
10th "	280
Total	12,680

Results of Examination

The samples, which were labelled respectively "1st fraction," "2nd fraction,"——"10th fraction," each consisted of 4 oz. of oil which was somewhat turbid owing to the presence of moisture. After filtration through paper the oils were clear and brownish in colour. The odour of all ten samples could be generally described as characteristic of cinnamon leaf oil, but that of Nos. 1-4 was definitely milder and less clove-like than the odour of Nos. 5-10.

On examination, the clear filtered oils were found to have the following constants, which are shown in the accompanying table in comparison with those recorded by Gildemeister (*Die Aetherischen Oele*: Gildemeister and Hoffmann, 3rd Edn., Vol. 2, p. 620) for commercial Seychelles and Ceylon cinnamon leaf oils.

Fractions of Seychelles Cinnamon Leaf Oil

Fraction.	1st.	2nd.	3rd.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	Commercial Cinnamon Leaf Oils* Seychelles.	Commercial Cinnamon Leaf Oils* Ceylon.
Specific Gravity at 15·5° C./15·5° C.	1·0470	1·0508	1·0566	1·0572	1·0579	1·0633	1·0603	1·0606	1·0621	1·0621	1·0206 to 1·0604	1·044 to 1·065
Optical Rotation α_D 20° C.	−0·71°	−0·60°	−0·63°	−0·76°	−1·37°	−1·09°	−0·97°	−1·04°	−1·25°	−1·10°	−2·5° to +1·5°	−0·25° to +2·33° (mostly dextro)
Refractive Index n_D 20° C.	1·5364	1·5372	1·5380	1·5382	1·5378	1·5393	1·5373	1·5382	1·5390	1·5390	1·533 to 1·537	1·531 to 1·540
Phenols (absorption by 5 per cent. KOH solution) *per cent.* (*v/v*)	83·0	86·2	88·5	87·2	87·3	90·4	90·8	89·3	89·2	90·0	78·0 to 94·0	65·0 to 95·0
Aldehydes as cinnamic (hydroxylamine method) *per cent.* (*w/w*)	3·47	3·47	2·52	2·05	1·75	1·65	1·16	1·25	1·22	1·10	0·0 to 5·0†	0·0 to 4·0†
Solubility in 70 per cent. (v/v) alcohol at 15·5° C.	Soluble in 1·3 vols.	Soluble in 1·3 vols.	Soluble in 1·3 vols.	Soluble in 1·25 vols.	Soluble in 1·25 vols.	Soluble in 1·2 vols.	Soluble in 1·2 vols.	Soluble in 1·25 vols.	Soluble in 1·25 vols.	Soluble in 1·2 vols.	Soluble in 1 to 1·5 vols. Some becoming opalescent on addition of more alcohol.	Soluble in 1 to 3 vols. Sometimes cloudy with more alcohol.
	No turbidity on further dilution of any of the fractions											

* *Gildemeister* (*loc. cit.*).

† *Bisulphite method, per cent.* (*v/v*).

It will be observed that the optical rotation of none of the samples falls within the range of this constant recorded by Gildemeister for Ceylon cinnamon leaf oil. The first four fractions have the lowest optical rotation; taking this constant and the odour into account it would appear that the 1st and 2nd fractions are closest to Ceylon cinnamon leaf oil.

Commercial Value

Samples of the fractions were submitted to (a) a firm of essential oil importers, (b) a firm of essential oil distillers, (c) a second firm of essential oil distillers, who furnished the following reports respectively:

(a) "The experiments do not appear to have had the result for which I had hoped. The first fraction is the one closest to the Ceylon oil, but I do not consider that it is sufficiently similar to this oil to recommend production and we must be content to continue to sell the natural Seychelles oil on its merits."

(b) "We consider that fractions Nos. 1 to 4 can be blended to give an oil which will approximate to Ceylon cinnamon leaf oil. This bulk will possess the characters of this oil."

(c) "Fractions Nos. 1 and 2 are the best in odour, but none could be considered as a substitute for Ceylon cinnamon leaf oil. The characteristic odour of the Ceylon oil is not entirely due to percentage of cinnamic aldehyde or to the lower eugenol content. Recent deliveries of Ceylon oil contained from 80-85 per cent. eugenol and 2·5 to 3·5 per cent. cinnamic aldehyde, about the same as in fractions Nos. 1 and 2.

"Seychelles cinnamon leaf oil is very satisfactory for certain purposes including the production of eugenol, but as a substitute for Ceylon oil even fractions Nos. 1 and 2 are unsatisfactory.

"We regret that this report is not as satisfactory as it might have been, but if it is found possible to get a better price for the fractions Nos. 1 and 2, the fractions 3-10, carrying a relatively higher eugenol content, might be found more interesting to buyers who purchase the oil mainly for its eugenol-bearing properties."

Samples of the 10 fractions of Seychelles cinnamon leaf oil, together with the results of the examination of these oils at the Imperial Institute, were considered at a recent meeting of the Imperial Institute Consultative Committee on Essential Oils. From the discussion which took place it was clear that the main desideratum would be the odour value of the oil in comparison with that of Ceylon cinnamon leaf oil. It was agreed that the early fractions from the experimental distillation in Seychelles showed an improvement in this respect on the odour of the straight oil, but they were still below the standard of the Ceylon oil.

Remarks

As was to be expected, the results of examination of the present

samples showed that the earlier fractions contained less eugenol and more cinnamic aldehyde than the later ones. This probably accounts for the milder and more pleasant odour of the early fractions.

The opinions of the trade were, on the whole, however, unfavourable on the odour of the early fractions when compared with Ceylon cinnamon leaf oil. The trade considered that even fractions Nos. 1 and 2 would not be able to compete successfully with the Ceylon oil in a normal market. The Seychelles oil is purchased to-day mainly as a source of eugenol for the manufacture of vanillin. As an alternative to the production of a straight oil for this purpose, one of the firms of distillers which were consulted suggested, as mentioned above, that fractions Nos. 3 to 10 carrying a somewhat higher eugenol content than the straight oil might be of more interest to vanillin manufacturers than the entire oil, but the production of fractions Nos. 3 to 10 would be dependent on the market for fractions Nos. 1 and 2 being remunerative, and the general opinion of the Consultative Committee was that although the early fractions were an improvement on the entire oil, they were not sufficiently near to Ceylon oil in quality of odour to justify a recommendation for fractionation on a commercial scale.

LEMONGRASS OIL FROM TRINIDAD

By D. J. Cosgrove, B.Sc., A.R.I.C., and H. T. Islip, B.Sc., F.R.I.C.

In connection with the development of an industry in Trinidad, experimental trials have been undertaken in the cultivation of lemon grass and satisfactory yields have been obtained. A sample of the oil prepared by steam distillation from the grass produced in these trials was received at the Imperial Institute in June 1946, and the results of its chemical examination and a report on its commercial value are given below. In view of this satisfactory report, efforts are being made to extend the cultivation of lemon grass in Trinidad. One suggestion made with this end in view is that the peasants should grow the grass in otherwise wasted corners and should sell their produce to some central buying agency.

Results of Examination

The sample consisted of 1 pint of dark brown, turbid oil, containing some separated water and having the characteristic odour of lemongrass oil. After filtration through paper the oil was clear but still very dark in colour.

On examination the clear, filtered oil was found to have the following constants, which are shown in comparison with the ranges of corresponding figures recorded by Gildemeister (*Die Aetherischen Oele*: Gildemeister and Hoffmann, 3rd Edn., Vol. 2, pp. 302-323.) for commercial East Indian and West Indian lemongrass oils:

	Sample.	Commercial lemongrass oils (Gildemeister). East Indian.	West Indian.
Specific Gravity at 15·5° C./15·5° C.	0·8969	0·899 to 0·905 (exceptionally 0·895 to 0·911)	0·870 to 0·912
Optical Rotation a_D20° C.	−0·18°	−5·0° to +1·40°	−1·0° to +0·2°
Refractive Index n_D 20° C.	1·4880	1·483 to 1·488	1·482 to 1·489
Aldehydes (bisulphite method) *per cent.* (*v/v*)	82·8	70 to 85	53 to 83
Aldehydes, as citral (hydroxylamine method) *per cent.* (*w/w*)	80·4	—	—
Solubility in 70 per cent. (v/v) alcohol at 15·5° C.	Soluble in 2·3 vols., with slight opalescence.	Soluble in 1·5 to 3·0 vols.	Only very fresh oils soluble. Older oils insoluble.

The foregoing results show that the present sample of lemongrass oil from Trinidad is of the soluble East Indian type.

Commercial Value

The oil was submitted to (a) a firm of essential oil importers and (b) a firm of essential oil distillers, who furnished the following reports respectively:

(a) "I note with interest the analytical figures and after examination of the sample I am of the opinion that it would meet with a ready market.

The present value of the Cochin oil is about 16s. per lb. for shipment and in my opinion the Trinidad oil should fetch quite as much. The fact that it has such a high citral content by the hydroxylamine method might induce isolate manufacturers to pay a slight premium.

In advising the producers of the present value I think you should also inform them of the prices that ruled prior to the war, as the level was then very much lower, in the region of 1s. 6*d*. to 2*s*. 6*d*. per lb. The present high level is due to the excessive demand caused by the absence of supplies of Java citronella oil."

(b) "The odour value of this oil is quite satisfactory and the characters, as quoted, are those of a normal oil. The market cost of lemongrass oil is given as 16*s*. 9*d*. per lb. c.i.f."

Remarks

The present sample of lemongrass oil from Trinidad is of the type referred to as East Indian or Cochin lemongrass oil, distilled from *Cymbopogon flexuosus* Stapf., and quite distinct from the less valued (in normal times) West Indian oil, obtained from *C. citratus*, Stapf. By reason of its solubility in 70 per cent. alcohol, oil as represented by the present sample would be suitable for direct use in perfumery, though for this purpose the dark colour may be a disadvantage, and its high citral content renders the oil particularly suitable for the isolation of this aldehyde for the manufacture of ionones. The oil should be able to compete on level terms with Cochin lemongrass oil even in a normal market.

With regard to the packing of the oil, it was noticed that separated water was present. This should be avoided, by allowing the water to settle out and removing it before packing, as it is well known that prolonged contact with water tends to lower the citral content of lemongrass oil.

OCIMUM SUAVE OIL FROM KENYA

By H. E. Coomber, B.Sc., and D. J. Cosgrove, B.Sc., A.R.I.C.

A sample of oil derived from *Ocimum suave*, Willd. was received from Tanganyika in 1938 and the results of its chemical examination have been published in this Bulletin (1941, **39**, 221). More recently, namely in 1944, another sample of this oil produced, however, in Kenya was forwarded to the Imperial Institute. The oil had been distilled from the green shoots and flower spikes (consisting mainly of young fruit as the flowers had mostly passed). The plantation had been started from the seed of one plant which was found growing by the wayside at about 6,000 ft. Although the leaves are strongly scented with a clove-like odour, the oil has little, if any, of this scent.

As the oil is being used in Kenya by one of the foremost local soapmakers to perfume some of his products, it was desired to ascertain whether it would have any commercial value in the United Kingdom market. With this end in view, the oil was chemically examined and also submitted to the trade in this country.

Results of Examination

The sample amounted to about 8 fl. oz. of pale greenish-yellow oil, having a pleasant, rather indefinite odour. It was filtered through paper, in order to remove a slight turbidity.

On examination the clear, filtered oil was found to have the following constants, which are shown in comparison with those of a sample of oil of *Ocimum suave* Willd. from Tanganyika examined at the Imperial Institute in 1938 (*loc. cit.*):

	Present sample.	Previous sample from Tanganyika.
Specific Gravity, 15·5° C./15·5° C.	0·9706	0·9696
Optical Rotation α_D20° C.	−19·92°	−22·25°
Refractive Index n_D 20° C.	1·5188	1·5188*
Acid Value, mg. KOH/gm. oil	1·4	—
Aldehydes and/or ketones (bisulphite method) *per cent.* (*v/v*)	2·1	—
Phenols (by absorption in 5 per cent. caustic potash solution) *per cent.* (*v/v*)	7·5	53
Solubility at 15·5° C.—		
In 70 per cent. (*v/v*) alcohol	Insoluble in 15 parts	—
In 80 per cent. (*v/v*) alcohol	Soluble with opalescence in 10 parts	—
Determined and expressed on the aldehyde and phenol-free oil		
Ester Value, mg.KOH/gm.	2·4	—
Ester Value after acetylation, mg.KOH/gm.	32·4	—

* *At 21° C.*

It will be seen that, although the physical constants of the present sample of oil agree closely with those obtained with the sample of *Ocimum suave* oil from Tanganyika examined at the Imperial Institute in 1938, the phenol content is very much lower than that of the Tanganyika sample. As the chemical examination showed the presence of only very small amounts of other compounds, it was thought desirable to carry out a fractional distillation of the oil in vacuo, in order to arrive at a more complete knowledge of the composition of the oil.

116 ml. of the original oil were treated first with sodium bisulphite and then with 5 per cent. caustic potash solutions in order to remove aldehydes, ketones and phenols. The remaining oil (in all 91 ml.) was dried in nitrogen on a water bath, and then submitted to fractional distillation at 20 mm. pressure in an atmosphere of nitrogen. After two distillations the following fractions were finally obtained:

Fraction No.	Boiling range.	Volume.
	° *C.*	*ml.*
1	74–85	1·5
2	85–105	1·5
3	105–128	6·5
4	128–135	10·5
4a*	135–140	52·0
5	140–142	1·75
Residue		16
Total		89·75
Loss		1·25

* *Fraction 4a distilled mainly at* 138° *C.*

Examination of the Fractions.

The physical constants of the fractions from the distillation were determined, as far as possible, with the following results.

Fraction No.	Specific Gravity at 15·5° C./15·5° C.	Refractive Index n_D 20° C.	Optical Rotation a_D 20° C.
1	—	1·4930	—
2	—	1·5040	—
3	—	1·5160	—
4	0·9948	1·5205	+2·64°
4a	1·0145	1·5269	+4·52°
5	—	1·5301	—

Fraction 1.—This fraction possessed a slight lavender-like odour, but could obviously contain little linalol (b.p. at 20 mm. 97°C.), or linalyl acetate (b.p. at 20 mm. 138°C.) owing to its low boiling range. It remained liquid when stored in nitrogen, but when air was admitted to the tube it gradually changed to a pale greenish-yellow resin.

Fraction 2.—This resembled Fraction 1 in odour, but resinified on storing, even under nitrogen. The resin was similar to that given by Fraction 1 but less viscous and deeper yellow in colour.

The tendency of both these fractions to resinification indicates that Fractions 1 and 2 probably contained myrcene (b.p. at 20 mm. 68°C.) and/or ocimene (b.p. at 20 mm. 74°C.), but there was insufficient of either fraction to confirm this.

Fraction 3.—The odour of this fraction recalled that of linalol. However, on warming a portion with dilute chromic acid solution no smell of citral was produced, thus indicating the absence of geraniol and linalol. Owing to the small size of the fraction it was not possible to examine it further.

Fractions 4 *and* 4*a*.—These fractions were almost odourless. Fraction 4a was found to be soluble in 2 vols. of 70 per cent (v/v) alcohol and was, therefore, not a hydrocarbon, but could possibly be an ether.

A portion was oxidised with alkaline permanganate and an acid was isolated which on purification had a melting point of 181°C. This probably consisted of veratric acid $(OCH_3)_2\ C_6H_3COOH$ (M.p. 181°C.).

From this it was concluded that Fraction 4a consisted chiefly of methyl eugenol $(OCH_3)_2C_6H_3{-}CH_2{-}CH_2{=}CH$. (b.p. 248°C.), which on oxidation gives veratric acid.

This was confirmed by treating a portion of the fraction with bromine dissolved in chloroform. A bromo-compound was isolated which on recrystallisation melted at 77-78°C., the melting point of the bromo-dibromide of methyl eugenol.

In order to estimate the amount of methyl eugenol present a methoxy determination was carried out on some of the original oil from which the phenols had been removed. The presence of 61·3 per cent. of methyl ethers (calculated as methyl eugenol) was indicated, which is equivalent to 56·4 per cent. on the original oil.

Fraction 5.—This had no recognisable odour and was too small to permit of further examination.

Residue.—The residue remaining in the distilling flask after distillation consisted of a brownish resin. This was presumably formed by heat polymerisation of terpenic constituents of the oil.

Examination of the Phenols.

The phenols, which had a clove-like odour, were liberated from the potash solution by acidification and characterised as eugenol by preparation of its benzoate (m.p. 69-70°C.).

Other Constituents.

Owing to the small amount of aldehydes or ketones, acids and esters present in the sample, no attempt was made to identify these constituents.

Summary

The results of the foregoing examination indicate that the present sample of oil of *Ocimum suave* has the following composition:

	per cent. (w/w).
Aldehydes and/or ketones	2·1
Phenols, eugenol	8·3
Phenol esters, methyl eugenol	56·2
Free alcohols, probably mainly linalol . .	7·5
Esters, as $CH_3COO.C_{10}H_{17}$	0·8
Acids, as acetic	0·2
Undetermined, presumably mainly terpenes .	24·9

Remarks

Only one reference to oil of *Ocimum suave* could be traced in the literature. This was to an oil obtained by benzene extraction of the plant and subsequent treatment with alcohol (*Trav. Lab. Mat. Med., Paris,* 1929, **20**, 360). The oil was not examined but was described as having an odour recalling that of cloves and vanillin, and which was somewhat phenolic. The oil of *O. suave* from Tanganyika previously examined at the Imperial Institute and a similar oil from the Belgian Congo (see this *Bulletin*, 1943, **41**, 171) both differed from the present sample in containing much more eugenol. Many oils from other species of *Ocimum* have been examined and found to contain varying amounts, often considerable, of eugenol, thymol and methyl chavicol, and also linalol, citral, citronellal, methyl cinnamate, dihydrocuminic aldehyde, camphor, borneol and terpenes.

The present sample of *Ocimum suave* differs from oils obtained from other species of *Ocimum* in containing a large proportion of methyl eugenol, which is in fact its main constituent.

It seems unlikely that the oil will have any considerable market value as it can be of no interest to the manufacturers of isolates, and the oil is not sufficiently soluble in alcohol for direct use in perfumery.

A possible use would be in the perfuming of soap, but the price would be low owing to the many competitors in this field.

NOTES

Obituary.—Dr. D. Jordan Lloyd. We record with the greatest regret the passing of Dorothy Jordan Lloyd, M.A., D.Sc., F.R.I.C., Director of the British Leather Manufacturers' Research Association, and Chairman of the Imperial Institute Consultative Committee on Hides, Skins and Tanning Materials, who died suddenly on November 21st at Great Bookham, Surrey, at the age of 57.

Dorothy Jordan Lloyd was educated at King Edward VII High School, Birmingham, and at Newnham College, Cambridge. She began her career in biology, obtaining a double first at Cambridge in the Tripos, and at the same time she also took her London B.Sc. Her interest in bio-chemistry was aroused by a course of lectures given by Gowland Hopkins, and she subsequently gained an international reputation in this field of science. For researches in this

sphere she was awarded a fellowship at Newnham in 1913. It was in 1927 that Dr. Jordan Lloyd succeeded Dr. Pickard as Director of the Leather Research Association, the staff of which she had joined in 1921. This Association was still small in comparison with the importance of the industry which it served, and she succeeded in bringing it up to a size appropriate to the importance of that industry, despite the difficulties of the economic depression of the early 'thirties, and the dislocation caused by the last war.

As Chairman of the Consultative Committee, she served the Imperial Institute faithfully and with great success. She had a far-seeing appreciation of the requirements of the tanners in this country, and was able to apply her knowledge to the initiation of investigations of their raw materials, hides and skins, at their source in the countries of origin.

The outstanding tact and kindliness which she displayed were features of the Committee meetings over which she presided, and all who had the privilege to work with her felt that she was not only a very able leader but a kind-hearted and good friend.

Her death at the age of 57 is indeed a great loss to the leather industry and to the field of science with which she was connected.

Recent Research on Empire Products in Nigeria.—The following information relating to research work carried out in Nigeria during 1945-46, or still in progress, is taken from a report sent to the Imperial Institute by the Acting Chief Conservator of Forests.

The exploitation of all merchantable species in the sample square mile in the Sapoba Reserve in Benin Province was completed in June of this year (see this BULLETIN, 1945, **43**, 275). Altogether, 283,000 cubic feet of merchantable timber, or approximately 442 cubic feet per acre, were obtained, and this figure has been used as a basis for the calculation of the financial return in the Benin Forests which are now under Working Plan.

Ecological research has been undertaken by the Forest Botanist in the Shasha Forest Reserve in Ijebu-Ode Province and the Afi River Reserve in Ogoja Province. The considerable amount of data collected during these investigations is now being analysed and the results will be published in due course.

The Forest Herbarium at Ibadan re-opened in October when the Assistant Conservator in charge returned from leave. The herbarium is now five times the size it was in 1942 and includes over 20,000 sheets. It is expanding very rapidly and receiving accessions both from Nigeria and other parts of West Africa. Duplicate material is sent to the Herbarium of the Royal Botanic Gardens, Kew; to the Department of Botany, British Museum (Natural History); to the Herbarium of the Department of Forestry, Oxford; and to the Smithsonian Institute.

Experiments with a large number of exotic trees, mainly of the genera *Pinus*, *Cupressus* and *Eucalyptus*, have been initiated on

the Bamenda Plateau in the British Cameroons with seed obtained from South Africa. It is still too early to make any pronouncement as to the success or otherwise of these. Balsa (*Ochroma* sp.) proved to be a failure and the experiments were abandoned. It did not grow sufficiently fast to produce timber of the required quality.

Bhilawan Shell Liquid.—Bhilawan shell liquid is obtained from the pericarp of the Bhilawan nut, also known as the marking nut, on account of the use of this liquid for marking linen indelibly.

The tree (*Semecarpus anacardium*) which yields these fruits is a deciduous tree growing under forest conditions in Central and Southern India and along the Sub-Himalayan tract, up to an altitude of 3,500 ft. It is found throughout the hotter parts of India as far east as Assam. This tree also occurs in the West Indies and Australia. It grows to a height of from 20 to 40 ft., with a girth of 4 to 6 ft. The fruit is a drupe, 1 in. long and nearly as broad. The upper part of the fruit is cup-shaped, smooth, fleshy, orange-red in colour and when ripe, sweet and edible. The lower portion, termed the nut, consists of a smooth, black, shining pericarp, which contains a corrosive resinous juice which is brownish or black when the fruit is ripe and has strong vesicant properties. The average dimensions of the nut are 1 in. long, $\frac{3}{4}$ in. broad and $\frac{1}{3}$ in. thick, and its average weight is 3·5 grams. Inside the nut and protected by a hard shell is a white kernel, which is stated to be as sweet and nutritious as the almond or cashew kernel.

The resinous juice occurring in the honeycomb structure of the pericarp has been investigated by several observers. Naidu in 1925 obtained the juice from Bhilawan nuts by making superficial incisions in them, care being taken that the cuts did not penetrate the hard shell covering the kernel. These treated nuts were then extracted with ether and gave a yield of 21 per cent. of a thick dark oil. Another method Naidu used was to crush the whole nuts between rollers and to extract the pasty mass with cold light petroleum. The extract after removal of the solvent was shaken with cold alcohol (90 per cent. v/v) in which the oil from the kernels is insoluble. After removal of the alcohol from the solution and washing with water to remove catechol, a yield was obtained of 18·5 per cent. expressed on the whole nuts. This observer reported the presence of the following constituents in the juice extracted: catechol 0·4 per cent.; anacardol 37·3 per cent.; two phenolic acids, $C_{17}H_{16}O_5$ and $C_{15}H_{14}O_5$, 4·4 per cent., which can be separated by means of their barium salts; another acid and a sugar.

Later, Pillay and Siddiqui in their examination of Bhilawan shell liquid did not find any anacardic acid or cardol which are present in cashew nut shell oil nor any anacardol or catechol as shown by Naidu to be constituents of Bhilawan shell liquid. They isolated from the juice, of which a yield of 28 to 36 per cent. was obtained by extraction of the nuts with ether, semecarpol, 0·1 per cent., a

monohydroxyphenol, b.p. 185-190°C. at 2·5 mm. and solidifying below 25°C. to a fatty mass; bhilawanol, an ortho-dihydroxy compound, $C_{21}H_{32}O_2$, 46 per cent., distilling at 225-226°C. at 3 mm., and solidifying below 5°C.; and a tarry corrosive residue, yielding no identifiable compound.

Bhilawan shell liquid has been used in India for medicinal purposes. Diluted with emollient oils it is employed externally in the treatment of skin affections and internally for rheumatic complaints, epilepsy and nervous debility. Recently, considerable interest has been displayed in the use of this material for industrial purposes. Ajamani, in 1942, published a paper on the preparation of baking enamels from Bhilawan shell liquid. He used for his tests the product obtained by the extraction of the crushed whole nuts with cold petrol. He found that he could prepare from this product stoving enamels with hard, glossy and elastic properties, the films showing good resistance to water, acid, petrol, alkali and heat. When kept for 45 minutes at 280-300°C., polymerisation of the shell liquid took place with a loss of 14 per cent. The polymerised product, after the addition of turpentine and polymerised linseed oil gave stoving enamels with satisfactory properties.

Investigations carried out since 1940 under the auspices of the Board of Scientific and Industrial Research, India, have led to the working out of processes for converting Bhilawan shell liquid into non-vesicant, semi-solid to solid products, which can be used in the manufacture of lacquers, varnishes, enamels, insulating materials and moulding plastics. Siddiqui found that on boiling this shell liquid with formaldehyde and hydrochloric acid or on heating it with a metal catalyst, or on heating it to 200°C. with 0·5-5·0 per cent. of sulphur, it was transformed into a black resin, which when thinned with solvent and applied to metal surfaces and baked at 140-200°C. formed very tough, hard, elastic films, resistant to acids, alkalis, and most organic solvents and withstanding temperatures as high as 300-350°C. Bhilawan shell liquid has also been employed for regenerating rubber waste for the production of hard, semi-hard and soft rubber goods. The use of a chlorinated product of this shell liquid as a co-solvent for rotenone extracts in insecticidal preparations has been patented.

Bhilawan shell liquid can be prepared by solvent extraction of the nuts or by heating them. Up to about 1943 it was not being produced on a commercial scale. In that year a special plant was designed and constructed for its large-scale production. The plant consisted of a series of inclined iron retorts of semi-elliptical cross section, placed in fire-brick chambers, provided with dampers and connected by flues to the fireplace and chimney. The furnace ensured a temperature control within ±25° from 200-500°C. In this process, which is being employed on a commercial scale, the shell liquid obtained does not contain any bhilawanol and consists entirely of a semi-polymerised product. It cannot, therefore, be

used in cases where the presence of bhilawanol is essential, but it is suitable for the production of enamels, lacquers, varnishes and certain other plastic compositions. Siddiqui and Khan have evolved an improved process in which the shell liquid is obtained by exposing the nuts to superheated steam at temperatures ranging from 180-230°C. in closed retorts, provided with an inlet for steam and an outlet for the expelled shell liquid. The product obtained by this improved process is comparable with that obtained by solvent extraction.

Statistics are not available to show the quantities of Bhilawan nuts that could be collected annually, but it is stated on the strength of reports from the Central Provinces, Madras and Hyderabad State that with proper organisation nearly 50,000 tons of these nuts could be gathered every year.

BIBLIOGRAPHY

Naidu, D.S. *J. Indian Inst. Sci.*, 1925, **8A**, pt. 9, 129.
Pillay, P. P. and Siddiqui, S. *J. Indian Chem. Soc.*, 1931, **8**, 517.
Siddiqui, S. *J. Sci. Industr. Res. India*, 1942, **1**, 17.
Ajamani, G. M. *J. Indian Chem. Soc.* (*Industr. & News Edn.*), 1942, **5**, No.1, 22.
Siddiqui, S. *J. Sci. Industr. Res., India*, 1946, **4**, 732.
Siddiqui, S. and Khan, A. A. *Indian Patents* Nos. 28002-5 (1941), 28424 (1941), 29051 (1942), 29938 (1943), 32237 (1945).
Caplan, S. and Schaufelberger, W. F. *U.S. Patents* Nos. 2,338,230-1 (1944).
Harvey, M. T. *U.S. Patent* No. 2,368,709 (1945).

G. T. B.

Consultative Committee on Silk.—In 1916, when there was a serious shortage of silk for war purposes, the Imperial Institute appointed an Advisory Committee on Silk Production to investigate the sericultural and economic possibilities of silk-raising in Empire countries. The late Sir Frank Warner, K.B.E., served as Chairman of this Committee and on his death he was succeeded by Mr. Norton Breton, M.B.E. (Milit.).

For a period of nearly twenty years the Committee fostered preliminary sericultural trials in a number of Empire countries and arranged for the examination of the resultant experimental material. A feature in its work was the visit in 1929-30 of Mr. Norton Breton to the Union of South Africa, Southern Rhodesia, Nyasaland, Tanganyika and Uganda to report on the possibilities of sericulture in these countries. However, adverse economic circumstances prevented useful developments at that time and the stage of wider experiments to follow up the initial trials was never reached. The Committee was finally dissolved in 1937 as a result of the difficulty of encouraging Empire sericulture in competition with the Japanese industry.

Following the war and the collapse of Japan there has been a renewal of interest in the possibilities of sericulture in Empire countries. Though the future economic position of Empire silk is still somewhat obscure, it has been felt desirable to reform the Committee in order to survey the position, and to aid in the provision of

technical assistance and advice to those in the Empire who are experimenting with sericulture or who contemplate making such experiments. Accordingly, the Committee was reconstituted in 1946 as the Consultative Committee on Silk under the Chairmanship of Mr. E. W. Goodale, C.B.E., M.C., and has already held three meetings. The present membership, representative of the Silk Industry in this country and of official agencies, is as follows: Messrs. Lloyd Armitage, R. R. Catty, Lady Hart Dyke, Messrs. P. W. Gaddum, E. W. Goodale, W. T. Hall, Dr. F. O. Howitt, Messrs. J. Sugden Smith and W. R. Wadsworth (The Silk and Rayon Users' Association); Miss A. B. Horan, Mr. S. Wade, Miss R. J. Whyatt (Joint Industrial Council for the Silk Industry—Workers' Side); Mr. H. O. Hambleton, O.B.E., Mr. E. L. Mercier (Board of Trade); Mr. G. M. Roddan (Colonial Office); Mr. A. J. Gibson (Office of the High Commissioner for India); Mr. Roger E. Norton, O.B.E. (Commissioner, The East African Office); Capt. S. T. Binstead (Trade Commissioner for Mysore); Miss C. B. Hitchens (Government of Cyprus Office); Dr. W. J. Hall, M.C. (Imperial Institute of Entomology); with Mr. E. H. G. Smith (Imperial Institute) as Secretary. Mr. G. F. Clay, C.M.G., O.B.E., M.C. (Agricultural Adviser to the Secretary of State for the Colonies), Sir Harold Tempany, C.M.G., C.B.E. (Chairman, Advisory Council on Plant and Animal Products, Imperial Institute), Sir Harry Lindsay, K.C.I.E., C.B.E. (Director of the Imperial Institute), Dr. J. R. Furlong (Principal, Plant and Animal Products Department, Imperial Institute) and Miss R. M. Johnson (Imperial Institute) attend meetings of the Committee.

One of the first acts of the new Committee was to appoint a Technical Sub-Committee. This Sub-Committee (Chairman: Mr. Gaddum. Members: Mr. Lloyd Armitage, Lady Hart Dyke, Dr. Howitt, Mr. Wadsworth) has prepared a Memorandum for the guidance of those considering the development of sericulture in the Empire, which is printed in the following pages. There is some shortage of literature in the English language on the subject of sericulture, but through the co-operation of the Director of Agriculture, Cyprus Agricultural Leaflet No. 8 (Educational Series) has been made available for reproduction and circulation by the Imperial Institute as a guide to those wishing to experiment. Mimeographed copies of the leaflet and extra copies of the Memorandum are obtainable from the Imperial Institute.

In the Consultative Committee on Silk, the Imperial Institute now possesses the services of an expert body to advise on technical questions affecting the development of sericulture in Empire countries. The Imperial Institute would thus especially welcome sericultural inquiries from the Empire as the members of the new Committee are anxious to do anything in their power to assist those who may be attempting or considering new developments in connection with Empire produced silk.

Memorandum for the Guidance of those considering the Development of Sericulture in the Empire.—This memorandum has been drawn up by the Technical Sub-Committee of the Imperial Institute Consultative Committee on Silk under the Chairmanship of Mr. P. W. Gaddum, with the object of providing information concerning the sericultural industry and the world trade in silk, which will be of assistance to departmental authorities and intending sericulturists who are contemplating the production of raw or waste silk in Empire countries. It indicates the factors concerned in finding a successful market for the produce, and should be of assistance in judging the prospects of introducing sericulture into new areas. By the courtesy of the Director of Agriculture, Cyprus, with this memorandum is circulated a copy of "Sericulture," by Ph. Christodoulou, *Leaflet No. 8, Educational Series* (with an addendum on the preparation of silk-gut) issued by the Department of Agriculture, Cyprus, which provides a useful preliminary guide to the practice of sericulture.

Immediately before the 1939-45 War, it was estimated that the world produced some 950 million lb. of fresh cocoons, yielding about 108 million lb. of raw silk, of which Japan and Korea produced 79½ per cent., China 10 per cent., Italy 4 per cent. and Russia 3½ per cent., the balance being distributed amongst the Balkans and the Near and Middle East. These figures exclude India, whose production was not accurately known. More interesting, however, are figures indicating world trade in raw and thrown silk, which may be tabulated as below, the vertical column showing importers and the horizontal column exporters. These are in thousands of lb. and are not necessarily exact. It should be noted that they are based on the statistics of a year (1938) in which much of China was occupied by the Japanese.

In thousands of lb.

	Japan.	China.	Italy.	France.	Switzerland.	Others.	Total.
United States	51,300	1,570	2,275	—	—	15	55,160
United Kingdom	4,560	270	145	—	—	330	5,305
France	3,900	1,360	125	—	—	10	5,395
Germany	545	2	1,590	75	170	150	2,532
Switzerland	500	60	430	135	—	45	1,170
Italy	55	—	—	—	—	—	55
Australia	1,030	—	—	—	—	—	1,030
Canada	35	—	—	—	—	—	35
India	30	—	—	—	—	—	30
	61,955	3,262	4,565	210	170	550	70,712

From the above, it will be noted that as an exporter Japan (with which was included Korea) accounted for 87½ per cent. of the total and that of the importers the United States took 78 per cent. of these exports. United Kingdom purchases were comparatively small, but it must be remembered that this country bought large quantities of silk in the form of fabric and made-up goods; any reduction in the import of foreign silk fabrics to the United Kingdom should increase imports of raw materials.

Such then is a picture of consumption and production in weight,

but a prospective raw silk producer must further study the all-important matters of quality and cost.

Since historic times the culture of univoltine silkworms was confined to a belt of the Eastern hemisphere extending from 30° to 45° North. It is in this belt that natural climatic conditions are found suitable for the purpose, but modern progress and artificial hibernation have now opened up a wider field. Ideally silkworm rearing requires a spell of dry weather, if possible following rain, the latter condition being to promote a flush of mulberry foliage and the former to facilitate the actual rearing process, which demands an even (or rising) temperature between 70° and 90° Fahrenheit. Excessive humidity and heavy falls of night temperatures are detrimental and may require the extra expense of artificial heating. Mulberry will grow in almost any soil and climate.

Apart from Cantons, which were used especially in the manufacture of crepes, all the chief exporting countries were concentrated on univoltine breeds of silkworms, normally producing a single crop each year. Even where more crops were produced, as in Japan, second or third hatchings were induced by artificial methods, in a univoltine breed, and thus no deterioration took place in the quality. It has yet to be shown that multivoltine silk worms, so well adapted climatically to conditions in the tropics where mulberry foliage can be brought into season throughout much of the year, can produce as fine a raw silk as is obtainable from univoltine breeds. United Kingdom users have a preference for white silk, chiefly due to the rather lower gum content and greater ease in dyeing, and this should certainly be taken into account where sericulture is being introduced into new territory. It is recognised that in countries where yellow silk has been the vogue for centuries it is well-nigh impossible to make a change in face of the strong conservatism of peasant folk; efforts have been made in Italy, but have never succeeded.

Initially it will be necessary to import silkworm eggs, and this should be done at any rate for the first few seasons. In order to prevent disease and especially the hereditary disease of pebrine, it is essential that reproduction is only undertaken with the greatest care, which entails microscopical examination of all female moths used for this purpose. In all countries where silk production is practised on any scale it has been found necessary to introduce legislation to control reproduction and the import of silkworm eggs, and in any territory where the appropriate regulations do not already exist it is a matter for the Department of Agriculture to consider their introduction once sericultural developments justify such action. In Cyprus, where strict control has been exercised now for many years, the occurrence of pebrine has been reduced to only 3 per cent. Of the various races of silkworms, Chinese white or Baghdad white, preferably the former, produce a good white silk such as is popular in the United Kingdom.

Cyprus provides a convenient source of silkworm eggs (or

" seed "), which can be obtained by direct application to the Silkworm Egg Producers' Co-operative Society, Kalopanayiotis, Cyprus. The production of the eggs is supervised by the Department of Agriculture, and all boxes of eggs are sealed with an official banderolle which indicates the quantity of eggs in each box and their variety; no actual certificate is issued. Arrangements could be made, however, to certify eggs as (a) produced under the Pasteur cellular system from moths microscopically examined under the supervision of the Department of Agriculture for the elimination of pebrine, (b) free from any admixture of foreign substances, (c) not artificially coloured, (d) not including more than five per cent of infertile eggs. Cyprus can supply eggs of a number of yellow races and a limited amount of Baghdad white eggs. Should large quantities of any variety be required it would probably be necessary to place an order in the spring. The eggs are laid in June and failing the receipt of orders in advance a large surplus for export is unlikely to be available. The Imperial Institute Consultative Committee on Silk is making inquiries regarding suitable sources of Chinese white silkworm eggs. Intending sericulturists would be well-advised to consult their Department of Agriculture before proceeding to order silkworm eggs and to embark on sericultural experiments.

The question of mulberry must be studied in the light of local conditions. The main choice lies between the bush and the tree: the former gives the greater yield of foliage per acre, but is vulnerable to goats and cattle: the latter can be employed on land which would otherwise be wasted, such as verges and boundaries, but is not so easy for harvesting. In the heyday of sericulture in Japan, prior to the last war, upwards of seventy per cent. of the acreage devoted to mulberry was planted on the bush (Negari) method with some 3,000/3,500 plants per acre, spaced in rows from 5 to 6 ft. apart, at intervals of 2 to 3 ft.: such bushes were pruned annually almost to ground level. A further fifteen per cent. was planted with approximately 1,500 plants to the acre at intervals of from 4 to 6 ft., in rows 6 ft. apart: under this method, which is termed Nakagari, the plants were pruned to within 3 ft. of the ground. Another five per cent. was devoted to pruned trees (Takagari) spaced at intervals of 12 ft. by 12 ft. and allowed to grow to heights of 8 or 9 ft. The balance of mulberry foliage harvested in Japan was derived from unpruned trees. It is interesting to note that the figures of the preceding ten years had shown a tendency towards an increase in bush plantations.

Cocoons represent a very bulky cargo, measuring some 760 cubic feet per ton of dry cocoons and it is economical, therefore, to reel them in the vicinity of production. Before embarking upon any commitment in this direction it would be advisable to study the various methods, if possible at first-hand. For many years the " Italian " method of boiling and brushing cocoons by child labour before going to the reeling basin was almost universal and still prevails in Europe and the Middle East. The requirements of the

hosiery trade have, however, called for greater and greater evenness and some years ago a new method was invented by a Japanese named Minorikawa and has been since widely introduced, both in Japan and China. In this case the cocoons are prepared for reeling by passing them in wire containers on an endless belt, moving first through steam before plunging into cool water; the sudden change of temperature has the effect of filling the cocoons with water to the extent of about 92 per cent., so that they only just float. These cocoons can be reeled very slowly and a single operator can tend as many as 20 ends, achieving a very high standard of evenness in the subsequent seriplane test. Automatic reeling machines are now in production and should also be considered.

However, before entering on expenditure for reeling machinery it would seem to be advisable to concentrate on the production of dry cocoons, for which there was a market before the war despite the bulkiness of the cargo. At the present time Lady Hart Dyke, The Lullingstone Silk Farm, Ltd., Eynsford, Kent, is a buyer of imported dry cocoons, and a second buyer within the Empire could probably be found in Paphos Industries, Ltd., of Limassol, Cyprus, while further outlets for dry cocoons may exist in India. Should it be intended to rear only a few hundred silkworms the most useful method of disposal might present itself in the form of silkworm gut for local use. A note on this, prepared by the Government of Cyprus, is appended to their leaflet on sericulture.

It is important to remember that the United Kingdom demand for raw silk is almost entirely confined to high grades. In this country, as in America, labour is dear and a first consideration is a good-winding silk. To achieve this it is the custom in the Far East to do the initial reeling on to rollers of only 24 in. circumference, the silk being afterwards re-reeled into the standard hanks of 59 in. thus removing all hard gums and loose ends before bundling and packing for export. The second consideration from the point of view of the buyer is evenness, and it was in fact usual to buy Eastern silk before the war entirely on the results of the Seriplane General Average Evenness test, without consideration of other factors.

Much publicity has recently been given to synthetic fibres and perhaps especially to Nylon. It is too early to say whether the new synthetics are going to succeed in ousting silk where their predecessors have failed, but the next few years should decide this issue. It seems likely that each will find its proper outlet and, while it is prophesied in the United States that Nylon will usurp 80 per cent. of the American hosiery trade, it must also be remembered that Japanese production has been reduced during the war to only 20 per cent. of its former importance and is not expected to return to within 40 per cent. of its pre-war figure before 1950. China, too, has suffered enormously as a silk producer during her eight years of Japanese occupation and it will take her many years to regain her old position.

Whatever may be the outcome of a trial of strength between silk and its new rivals, it is certain that silk can never command a fancy price and the question of cost will be a decisive factor. Just now when export prices are largely artificial, due to abnormal conditions and unnatural exchange rates, it is impossible to indicate a price at which silk could be sold on the world markets. It would be well for any prospective producer to calculate his probable costs and submit them for the advice of this Committee or, in the case of dry cocoons, to one or both of the possible buyers mentioned above before venturing too far on capital expenditure.

If questions arise in connection with the development of sericulture in Empire countries, which cannot be solved locally, the Imperial Institute Consultative Committee on Silk would be pleased to endeavour to assist. It is always advisable, however, first to consult local technical authorities.

BOOK REVIEWS

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

An Advanced History of India. By R. C. Majumdar, M.A., Ph.D.; H. C. Raychaudhuri, M.A., Ph.D.; and Kalikinkar Datta, M.A., Ph.D. Pp.xii + 1081, 5¼ × 8½. (London, Macmillan & Co., Ltd., 1946.) Price 28s.

India: A Re-statement. By Sir Reginald Coupland, K.C.M.G., C.I.E., Hon.D.Litt. Pp. viii + 311, 5¼ × 8½. (London: New York: Bombay: Humphrey Milford, Oxford University Press, 1945.) Price 12s. 6d.

If I were an Indian, I should find it difficult to reconcile the Indian chapters in any schoolboy's History of England with the story of the growth and continuance of the British connection with India as I see it. My mind would revolt at the prominence given to eighteenth and nineteenth century campaigns and battles. I would accept the Pax Britannica as the underlying motif, revealing itself more and more effectually as the British Raj became firmly established. I would be the first to recognise that the average Englishman in India is a type apart—quite different from the same Englishman as we Indians find him in the refined and refining conditions of life in his own homeland. I should be tempted to cry out for a history of Indo-British relations which should be written in slower and quieter tempo, more truly appreciative of the great movements which, under the surface, have directed both nations towards their present relationship.

Both the books here reviewed supply, in their very different manners and methods, answers to this appeal. Both recognise that the details of battles and campaigns may well be left to the expert in military tactics; that the results of campaigns are what really matter, and particularly the social, economic and political developments which follow; and that the progress of art and science, agriculture and industry, and above all, social welfare, is the real criterion of success in the life-story of a nation.

In other words, both authors (or rather, all four) have shaken off the conventional view of "history." The further back we go in time, the greater should be the tendency to skip non-essential details and to concentrate on the few really important land-marks which point the way to future developments—these land-marks being naturally rarer the further back we go. There is no reason behind the convention that history as such stops when modern politics begin. The only logical view is that history becomes more and more important as the political sense of the nation matures, as the tempo of the national life becomes more insistent and its politics more complex and more intense—culminating in the climax of to-day, the hopes and fears for to-morrow.

The *Advanced History of India* has been compiled on exactly these lines. It is written from the Indian point of view, but its references to the British connection are friendly and wise; and it gives proper value and emphasis to those numerous appreciations of India and the Indian which illustrious and far-sighted British rulers have from time to time expressed. The chapter entitled "The Dawn of New India," in particular, shows in what high esteem Raja Rammohan Roy was held by Englishmen of his day; and many other examples could be quoted. Indeed, many of the most severe Indian critics of the less liberal features of British rule in India afford evidence of the successful introduction to Indian minds of those very principles of humanity and fairplay for which Britain herself stands and has always stood. By a similar turn of events the American Colonies, in opposing England, upheld principles essentially English.

This is history as it should be written. If one criticises the three Indian authors, it is not on the ground of super-sensitively national views, but rather that they have not seen their way to carry the story of modern political developments quite as far as the Wavell régime. The Preface is undated. Probably printing difficulties held up the volume, which carries the history up to 1939. The authors should be encouraged to issue a supplement giving their views of political developments during the past few eventful years.

Sir Reginald Coupland's *India* is a smaller book, but one which also treats historical and political India with scrupulous fairness. The constitutional evolution of the country is prominent in the author's thoughts, and the historical setting is admirably designed

to put the political developments in their right perspective. Here again we have in this "re-statement" the right methods and treatment—the tempo of the book gradually intensifying, and political innovations so rapidly developing that, by pages, the Indian Councils Act of 1909 and subsequent measures and negotiations occupy the last two-thirds of the volume.

Documents 1 to 5, printed as an Appendix, illustrate in convenient form the social conditions in which the British found India, the various authoritative statements foreshadowing Indian self-government, the difficulties inherent in Hindu-Moslem relations, and finally the most up-to-date statements of British policy in and for India.

The two books are complementary to each other and might be sub-titled "Three Indians on India" and "An Englishman on India." Both together present a composite picture of which, discounting human errors and frailties, both nations may justly be proud.

H. A. F. L.

THE STORY OF GIBRALTAR. By H. W. Howes, M.A., M.Sc., Ph.D. Pp. 95, $7\frac{1}{4} \times 5$. (London: Philip & Tacey, Ltd., 1946.) Price 5s.

As the ace of trumps in the hands of a far-sighted player unobtrusively dominates the actions of all the kings and queens, so this bare, lonely rock has been in the hands of those who know how to play the game of world politics. Arab influence in Europe ceased when the first Duke of Medina Sidonia captured the Rock. The Spaniards lost it and their empire tumbled about its feet of gold. Since Rooke hoisted the Royal Standard under the very noses of the Dutch, who, incidentally, were claiming it for the Hapsburgs, it has remained a trump card in the hands of British statesmen, although many times it has come near to being thrown away to gain a single trick.

This, in brief, is the story Dr. Howes has to tell in this excellent little book. A better title might have been "Gibraltar in World History," for here is no simple, straight-forward story of one place. The reader is left with an impression that most of the major events of the last thousand years have been linked with the Rock. The book was written for those Gibraltarians now leaving the secondary schools of the peninsular, "that they may feel a sense of real pride in being members of both their own community and the British Empire." It is a pity that the author did not deem it necessary to write more of the Gibraltarians themselves, of their ways of life and of the parts they have played in the history of the Rock. Not enough is known of Gibraltar in the Empire, apart from her fortress and coaling station activities. Great names are scattered lavishly throughout the book, Euric the Visigoth, Eisenhower, Ferdinand

and Isabella, Hitler, Nelson, Marlborough, Churchill, to mention only a few. But they are all names of those whose interest in the Rock was transitory, who regarded it as a prize to be fought or schemed for and garrisoned and guarded with troops from overseas. Perhaps because of this formidable list of famous men to contend with, it has been impossible for any great Gibraltarian to emerge, or even for the inhabitants as a group to establish their identity on the pages of history.

The last chapter indicates very briefly the growth of a civic consciousness and suggests that the time has come for Gibraltarians to show that they are not merely appendages of a garrison town clinging to a barren rock. If we knew more about the people of Gibraltar, we might more easily form our own conclusions. Nevertheless, we can remember that it was a growth of civic consciousness and pride that once produced the men capable of building the Parthenon on a bare rock.

Dr. Howes ends with a warning and a hope. Gibraltar will remain the first outpost of the Colonial Empire and a shop window where many non-British visitors will get their first view of the Colonial Empire. "May everyone in Gibraltar, whatever his or her position and occupation, ever keep this fact in mind and be worthy of the City, the Fortress, and of British citizenship."

R. C. H. W.

ANNUAL REVIEW OF BIOCHEMISTRY. Vol. XV, 1946. Edited by J. Murray Luck. Pp. xiii + 687, $5\frac{3}{4} \times 8\frac{3}{4}$. (California: Annual Reviews, Inc., Stanford University P.O., 1946.) Price $5.00.

Vol. XV of this annual review contains twenty-one concise monographs on recent work and discoveries in various branches of biochemistry, ranging from medical to agricultural. The chapters have been written by acknowledged authorities in each particular field, representing four countries, America, Britain, Canada and Switzerland. It is difficult to single out for special mention any particular monograph, but amongst others which will probably interest readers of the *Bulletin of the Imperial Institute* are those on Organic Insecticides, Plant Carbohydrates, The Vitamins and Biochemistry of Yeast. Organic insecticides can be placed in two groups (*a*) those of plant origin and (*b*) synthetic. In the former group are such well-known substances as Nicotine (from *Nicotiana tabacum* and *N. rustica*), Rotenone (from *Derris*, *Lonchocarpus*, *Tephrosia*, *Milletia*), Pyrethrum (*Chrysanthemum cinerariaefolium*), etc., and other more recently discovered ones such as Sabadilla (*Schoenocaulon* spp.) and the Yam bean (*Pachyrhizus* spp.). Two pyrethrins (active ingredients of pyrethrum) have been recognised for a considerable time, both of which were thought to be esters of the same alcohol, pyrethrolone. It has now been shown that there

are in fact two alcohols, cinerolone and pyrethrolone (this name has been retained for the one) thus it would seem that there are not two but four pyrethrins. Amongst the synthetic organic insecticides are trichloroacetonitrite, the thiocyanates and two newer ones which have received much attention, D.D.T. (2,2-bis(p-chlorophenyl) -1, 1, 1-trichloroethane), and Gammexane, also called "666" (hexachlorocyclohexane). The name Gammexane is derived from the fact that it is the gamma isomer which is the most toxic. Its toxicity to house flies in particular is exceptionally high and in the form of a paraffin spray is nearly ten times that of D.D.T. Of the plant carbohydrates, the constitution of starch continues to attract attention; the action of amylase and the synthesis of amylose and amylopectin are also discussed. Other carbohydrates under consideration in this chapter are sucrose; and dextrans and levans, both of which are characteristically products of certain micro-organisms metabolising sucrose, but also occurring in some higher plants. Important features of this work are the comprehensive bibliographies appended to each section and the indexes, both author and subject, of the Review as a whole. There is no doubt that the *Annual Review of Biochemistry* is of the greatest value to all biochemists, covering, as it does, so many aspects of the subject, and the editors are to be congratulated on their discrimination which makes such a work possible.

I. C. S.

STRUCTURE DES ÉMULSIONS, DES ÉMULSOÏDES ET DES SUSPENSIONS UTILISÉS EN COSMÉTIQUE ET EN PHARMACIE. By Emile Mahler. Pp. 86, $9\frac{3}{4} \times 6\frac{1}{2}$. (Paris: Librairie Maloine S.A., 1946.) Price 200 francs.

This book, which deals with the physical chemistry of suspensions and emulsions used in cosmetology and pharmacy, should prove of value to manufacturers in assisting them to insure that such preparations are correctly compounded and possess suitable stability. The first fifteen sections deal with the theory of dispersions, etc. and their physical properties, *e.g.*, viscosity, surface tension, thixotropic phenomena, syneresis, durability and shearing stress. Methods are given for measuring the two latter properties. Sections 17-33 deal with true emulsions, their formation and the question of the continuous phase. A table of eighteen different products of emulsion type is included. The final sections, 34-48, include 8 plates illustrating emulsions etc. as viewed under the microscope, the examples being well described in the text. Examples are given of true emulsions, stearic emulsoids, complex emulsions, dispersions and fatty mixtures.

Very few faults are apparent in the printing, although a number of the diagrams could have been clearer.

R. W. P.

THE CHEMICAL ANALYSIS OF FOODS. By Henry Edward Cox, Ph.D., D.Sc., F.R.I.C. Third Edition. Pp. vii + 317, $8\frac{3}{4} \times 5\frac{1}{2}$. (London: J. & A. Churchill, Ltd., 1946.) Price 24*s*.

The third edition of this now well-known book is very similar in its general layout to the previous editions and may be considered a very useful contribution to the literature on the examination of foods and beverages in general use to-day. Among the new features in the latest edition which might be mentioned is a short description of soya products, including a table giving the composition of the beans themselves in comparison with that of the meal and flour. Included in the chapter on "Milk and milk products" is a paragraph on malted milk, giving not only the various methods of making this popular food, but also the analyses of some half dozen different types. Finally, towards the end of the book is a brief account of the determination of some of the best-known fat-soluble vitamins.

F. M.

pH AND PLANTS: AN INTRODUCTION FOR BEGINNERS. By James Small, D.Sc., Ph.C., F.R.P.S., M.R.I.A., F.R.S.E. Pp. vii + 216, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Baillière, Tindall and Cox, 1946.) Price 12*s*. 6*d*.

There has for some time past existed a need for a summarised account of hydrogen-ion concentration in relation to plant life. This situation has been cleared by Professor Small's excellent book.

The three introductory chapters discuss the meaning of the terms used, *p*H in general, the methods of determining *p*H, the action of buffers and the effects of carbon dioxide. It is in these chapters that one defect is observed; some considerable knowledge of physical chemistry is required to follow clearly the subject matter discussed. The remaining chapters describe the relationship between *p*H and plant sap, cell walls, protoplast, plant enzymes, aquatic life, soil reactions, plant pathology, succulents and cytoplasmic life. These chapters are followed by two appendices discussing hydrogen-ion activity, hydrogen-ion concentration and dissociation and acids respectively. Here again, however, these are slightly above a "beginner's" stage. The book concludes with a very useful selected bibliography and an extensive combined author and subject index.

The book is adequately supplied with graphs and tables which contain a large amount of data in a useful condensed form. The chapters dealing with *p*H and various aspects of plant life are very interesting and the book may be recommended to all professions in any way connected with plant life.

G. E. B.

THE USE OF HETEROSIS IN THE PRODUCTION OF AGRICULTURAL AND HORTICULTURAL CROPS. By T. Ashton. Imperial Bureau of Plant Breeding and Genetics. Pp. 30, 9¾ × 7¼. (Imperial Agricultural Bureaux, Central Sales Branch, Penglais, Aberystwyth, 1946.) Price 3*s*.

In the development of hybrid maize in the United States, the plant breeder has recently obtained an important success. Ten years ago hybrid seed was but little used, but by 1944 over 80 per cent of the maize acreage in the corn belt was sown to hybrid varieties. Such an achievement directs attention to the improvement in crop yields that may be obtainable by making use of hybrid vigour, and renders opportune this review of the literature of heterosis in crop plants.

Questions of the " why " of hybrid vigour are outside the scope of Miss Ashton's publication, though in passing it may be noted that research has yet to supply a fully satisfactory genetic explanation of this characteristic. The application of hybrid vigour is dependent on a number of factors. Maize, for instance, has certain advantages : hybridisation is readily effected by detasseling, each plant produces a fair quantity of seed, and the seed-rate is relatively low. Where hybrid vigour is exhibited and can be exploited, the plant breeder has another potential means of raising commercial yields.

E. H. G. S.

PLANTS AND BEEKEEPING. By F. N. Howes, D.Sc. Second Impression. Pp. 224, 9 × 5½. (London: Faber and Faber, Limited, 1946). Price 12*s*. 6*d*.

Dr. Howes, who is both a botanist (on the staff of the Royal Botanic Gardens, Kew) and an expert beekeeper, has in the present work combined these interests in a comprehensive account of the British bee-plants ; but in spite of being so complete an account, it has been written for the general reader and demands of him neither a knowledge of botany nor a knowledge of beekeeping. The author has taken advantage of the unique opportunities presented at Kew to observe, with meticulous care, the activities of bees in relation to the flowers growing there and has in this way accumulated a wealth of information on the relative value of these flowers to the bees.

There are three sections to the book, the first of which is of a general nature, dealing with the production of pollen and nectar by the flowers and related topics. An interesting note in this section is that on unpalatable and poisonous honeys ; some such as those derived from ragwort and privet are unpalatable, whilst other plants are sources of decidedly poisonous honey. It is, however, reassuring to find that in Great Britain poisonous honey is almost unknown. The possibilities of artificial bee pasturage are also discussed in this section, but unless the crops could be put to some

other use after flowering this would in most cases be an economically unsound proposition in this country, although the establishment of nectar plants in waste places might well repay the trouble taken.

Section two deals with a dozen or so of the major British honey plants, including clovers, limes, heather, fruit blossom, etc. White clover is by far the best bee-plant in this country and the honey derived from it is the honey with which all others are compared. Lime trees rank second to white-clover, but, unfortunately, often produce large quantities of honey-dew which may contaminate and spoil the whole of the honey crop. This is particularly the case in hot dry seasons. In the third section, which is also the longest, the other less important honey plants are discussed, some are common wild flowers of the country side, and some are common garden plants, others are less common exotics. In this respect the book should be of interest to beekeepers outside Britain since clovers, buckwheat, bush and tree-fruits and many other plants receiving mention in this section are common in many parts of the world.

The book is illustrated with many excellent photographs of flowers in their natural surroundings and close-ups of individual plants: there is also a short bibliography for those who wish to go more deeply into any particular aspect. Already in its second impression, it is obvious that this book is finding a well-deserved popularity with beekeepers and all those interested in flowers and bees.

I. C. S.

MODERN ORGANIC FINISHES. By R. H. Wampler. Pp. xii + 452, 8¾ × 5½. (Brooklyn, New York: Chemical Publishing Co. Inc., 1946). Price $8·50.

The finishing of manufactured articles, both from the point of view of appearance and of durability, has made considerable progress in recent years, particularly during the war, and for this reason, any book such as that now under notice should have a wide appeal.

In *Modern Organic Finishes* the author has divided his subject into six sections. Section I (of three chapters) is devoted to a short survey of the wide range of organic finishing materials themselves which are now available, including oleo-resinous and alkyd varnishes and enamels, spirit varnishes, cellulose lacquers, stains and fillers, while in Section VI (two chapters) "good practice in the finishing department" and "testing and evaluating finishes" are dealt with.

The intervening four sections, which comprise the bulk of the book, are given over to consideration of modern methods of applying the finishes (by spraying, dipping, flocoating, roller and knife coating, tumbling and by centrifugal means); of drying (air drying, force drying and baking by convection, radiant heat (infra-red baking) and the use of a high-frequency electrical field); handling in the finishing department; conveying methods; and finishing processes

for particular types of manufactured goods, among which may be mentioned wood furniture, paper, cardboard, plastics, plywood, metal castings, sheet steel products, motor cars, railway locomotives and aircraft.

In these four last-mentioned sections, where the majority of the 77 plates with which the book is illustrated appear, the ground is covered in considerable detail, the cleaning and preparation of the article for treatment for priming, stopping and subsequent coats being adequately treated, though the author, very rightly, is careful to advise the manufacturer to consult his suppliers of the raw materials on any points of difficulty which may arise.

The chemist may regret that more of the book has not been devoted to the nature and composition of the finishing materials themselves and that the testing of the finishes is not given in greater detail. This criticism is, however, largely met by the bibliography of 67 references at the end of the work.

Readers in general will find *Modern Organic Finishes* intensely interesting, whilst industrial users of organic finishing materials, such as manufacturers of home and office furniture and equipment, domestic appliances and a wide range of other products, from buttons to locomotives, golf tees to aeroplanes, will derive much assistance from a careful study of the book.

The author is to be congratulated on producing such a valuable work, the scope of which is more aptly described by its sub-title, "Their Application to Industrial Products" than the main title.

H. T. I.

SOME BRITISH BOOKS ON AGRICULTURE, NUTRITION, FORESTRY AND RELATED SCIENCES 1939-1945. Compiled by H. M. Bedlington. Joint Publication No. 11. Pp. v + 37, 10 × 7½ (Imperial Agricultural Bureaux, Central Sales Branch, Penglais, Aberystwyth 1946.) Price 3*s*.

In view of the many requests that have been received by them for bibliographies of recent British books, pamphlets and similar occasional publications on agriculture, forestry, nutrition and the related biological and other sciences, the Imperial Agricultural Bureaux have considered it advisable to issue a list of such publications as Joint Publication No. 11. Many of these books have already received notice in their abstracting journals.

In this publication the bibliography is arranged alphabetically under the authors' names, but an index of subjects is included. It should prove of value to all those interested in the literature of the subjects covered, but should appeal particularly to those overseas and away from centres of learning.

G. T. B.

BIBLIOGRAPHY

Compiled by Miss R. M. Johnson.

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the three months August-October 1946.

The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4 Millbank, Westminster, S.W.1. Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.

AGRICULTURE

General

Sixteenth Annual Report of the Executive Council of the Imperial Agricultural Bureaux, 1944-45. Pp. 28, 9½ × 7¼. (London: H.M. Stationery Office, 1946.) Price 1s.

Nineteenth Annual Report of the Council for Scientific and Industrial Research, Australia, for the year ended June 30, 1945. Pp. 164, 13 × 8. (Canberra: Government Printer, 1946.) Price 7s.

Report of the Department of Agriculture, New South Wales, for the year ended June 30, 1945. Pp. 32, 13 × 8. (Sydney: Government Printer, 1946.) Price 2s.

Annual Report of the Technological Museum, Sydney, New South Wales, for 1945. Pp. 3, 13 × 8. (Sydney: Government Printer, 1946.)

Annual Report of the Department of Agriculture, Basutoland, for the year ended September 30, 1945. Pp. 20, 8½ × 5½. (Maseru: Department of Agriculture, 1946.)

Annual Report of the Director of Agriculture, British Guiana, for 1944. Pp. 26, 13 × 8. (Georgetown, Demerara: The *Daily Chronicle*, Ltd., 1945.)

Annual Report of the Department of Agriculture, Cyprus, for 1945. Pp. 8, 13 × 8. (Nicosia: Government Printing Office, 1946.) Price 1s.

Annual Report of the Department of Agriculture, Jamaica, for the year ended March 31, 1945. Pp. 14, 13 × 8. (Kingston: Government Printer, 1946.)

Annual Report of the Agricultural Department, Nigeria, for 1944. Pp. 47, 9¾ × 6¾. (Lagos: Government Printer, 1946.) Price 2s.

Annual Report of the Secretary, Department of Agriculture and Lands, Southern Rhodesia, for 1945. *Rhod. Agric. J.*, 1946, **43**, No. 3, 237-265.

Annual Report of the Director of Agriculture, Trinidad and Tobago, for 1944. Pp. 16, 13 × 8. (Trinidad: Government Printer, 1945.) Price 16 cents.

Report of the Federal Experiment Station in Puerto Rico, U.S. Department of Agriculture, 1945. Pp. 62, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Annual Report of the Agricultural Experiment Station, Gainesville, Florida, for the year ended June 30, 1945. Pp. 229, 9 × 6. (Gainesville, Florida: Agricultural Experiment Station, 1945.)

Annual Report of the Department of Agriculture, Zanzibar, for 1945. Pp. 27, 13 × 8. (Zanzibar: Government Printer, 1946.) Price Shs. 2/-.

Annual Report of the Kizimbani Experiment Station, Zanzibar, for 1945. Pp. 48, 13 × 8. (Zanzibar: Department of Agriculture, 1946.) Mimeographed.

The Soil

Some Aspects of Soil Fertility in Cyprus. By L. Littlejohn. *Emp. J. Exp. Agric.*, 1946, **14**, No. 55, 123-134.

Preparation of Ammonium Nitrate for Use as a Fertiliser. By W. H. Ross, J. R. Adams, J. Y. Yee, *et al.* *Tech. Bull. No.* 912, *U.S. Dep. Agric.* Pp. 80, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 20 cents.

Pests—General

(For Insecticides of Vegetable Origin see p. 320.)

Benzene Hexachloride in Grasshopper Baits. By S. L. Allman. *Agric. Gaz. N.S.W.*, 1946, **57**, Pt. 4, 171-172, 182.

Gammexane and DDT Dips for Control of Arsenic-Resistant Blue Tick. By P. M. Bekker and H. Graf. *Frmg. S. Afr.*, 1946, **21**, No. 243, 361-366, 420.

Some Properties and Applications of DDT. *Publ. Minist. Supply.* Pp. 34, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 6*d.*

The Preparation of Some Emulsions containing DDT. By R. H. Hackman. *J. Coun. Sci. Industr. Res. Aust.*, 1946, **19**, No. 1, 77-85.

DDT to Control Hide Beetles. By D. D. Jensen and F. G. Holdaway. *J. Econ. Ent.*, 1946, **39**, No. 3, 283-286.

The Use of Adhesive Agents in DDT Sprays. By S. Barnes. *Bull. Ent. Res.*, 1946, **37**, Pt. 2, 173-176.

DDT and its Textile Applications. By F. L. Goodall, T. F. Gorton and J. V. Summersgill. *J. Soc. Dy. Col., Brad.*, 1946, **62**, No. 7, 189-198.

Toxicity of DDT Sprays to Livestock. By H. S. Telford and J. E. Guthrie. *Soap*, 1946, **22**, No. 9, 124-125, 133.

Foodstuffs—General

Nutritional Investigations in Mauritius, 1942-45. Final Report. Pp. 89, 9½ × 6. (Port Louis: Government Printer 1946.) Price Re. 1.

Beverages

Annual Report of the West African Cacao Research Institute, Tafo, Gold Coast, April, 1945, to March, 1946. Pp. 60, 13 × 8. (Tafo: West African Cacao Research Institute, 1946.)

Une Nouvelle Maladie à Virus du Cacaoyer en Afrique Occidentale: le Swollen Shoot. By P. Monnier. *Rev. Bot. Appl.*, 1946, **26**, No. 283-284, 166-173.

Sur les Caractères du "Swollen-shoot" en Côte d'Ivoire. By G. Mangenot, H. Alibert and A. Bassett. *Rev. Bot. Appl.*, 1946, No. 283-284, 173-184.

The Utilisation and Future of Clonal Cacao. By E. E. Cheeseman. *Trop. Agric., Trin.*, 1946, **23**, No. 5, 86-88.

Cereals

Classification of Barley Varieties Grown in the United States and Canada in 1945. By E. Aberg. *Tech. Bull. No.* 907, *U.S. Dep. Agric.* Pp. 190, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 35 cents.

A Study of Sorghum and Sorghum Starches. By F. E. Horan and M. F. Heider. *Cereal Chem.*, 1946, **23**, No. 5 492-503.

Sugar

Proceedings of the 1945 Meeting of British West Indies Sugar Technologists held at the Imperial College of Tropical Agriculture, Trinidad, under the auspices of British West Indies Sugar Association (Incorporated). Pp. 94, 11½ × 8½. (Barbados: Advocate Co., Ltd.) Contains a number of articles dealing with various aspects of the cultivation and preparation of sugar.

La Production du Sucre. By A. Matagrin. II. Le Sucre de Sorgho. *Rev. Int. Prod. Colon.*, 1946, **21**, Nos. 200-201, 83-87.

Rat Control on Hawaiian Sugar Cane Plantations. By R. E. Doty. *Bull. No. 55, Agric. Chem. Series, Exp. Sta. Hawaii. Sugar Plant. Assoc.* Pp. 170, 10 × 8½. (Honolulu: Hawaiian Sugar Planters' Association, 1945.) Reprinted from *Hawaii. Plant. Rec.*, 1945, **49**, No. 2.

The Utilisation of Sugar Cane Bagasse for Paper, Board, Plastics and Chemicals. An Annotated Bibliography. Edited by C. J. West. *Sci. Rep. Series No. 3, Sugar Res. Foundation, N.Y.* (New York: Sugar Research Foundation, Inc., 1946.)

Root Crops

Contribution à l'Étude de la Toxicité du Manioc au Congo Belge. By L. Adriaens. *Mem. Inst. Colon. Belge*, 1946, **13**, Pt. 4. Pp. 140, 9½ × 0. (Brussels: Royal Colonial Institute, 1946.)

The Potato. Methods of Cultivation in Southern Rhodesia. By S. D. Timson. *Rhod. Agric. J.*, 1946, **43**, No. 2, 146-167.

Quality of Potatoes in Relation to Soil and Season. I. The Content of Dry Matter. II. The Colour of the Cooked Potato. By H. G. Wager. *J. Agric. Sci.*, 1946, **36**, Pt. 3, 207-221.

Sweet Potato Starch. By R. F. Gould. *Chem. Engng. News*, 1946, **24**, No. 11, 1518-1520. Describes the manufacture of this starch and the cultivation of the crop as a large-scale operation in Florida.

Fruits

Annual Report of the Fruit and Vegetable Preservation Research Station, Campden, for 1945. Pp. 63, 9¾ × 6½. (Campden, Glos.: Research Station, 1946.)

Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, for 1945. Pp. 230, 9½ × 6. (Long Ashton: The Agricultural and Horticultural Research Station, 1946.)

Storage of Apples. By W. R. Phillips. *Publ. No. 776, Dep. Agric. Canada.* Pp. 35, 9¾ × 6. (Ottawa: King's Printer, 1946.)

Avocado Culture in New Zealand. By J. D. Kennedy. *N.Z. J. Agric.*, 1946, **73**, No. 2, 129-130.

Studies in Tropical Fruits. XVI. The Distribution of Tannins within the Banana and the Changes in their Condition and Amount during Ripening. By H. R. Barnell and E. Barnell. *Publ. Low Temp. Res. Sta., Trin.* Pp. 22, 9½ × 6. (Trinidad: Imperial College of Tropical Agriculture, 1945.)

Nutritive Value of Canned Foods. Factors Affecting Ascorbic Acid Content of Canned Grapefruit and Orange Juices. By F. C. Lamb. *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 8, 860-864.

The Cultivation of the Mango in the Dry Zone of Ceylon. By S. C. Gunaratnam. *Trop. Agric., Ceylon*, 1945, **101**, No. 4, 227-231.

Investigations on the Use of Sulphite Dips in the Drying of Peeled Pears and Peaches. By E. C. Orton. *J. Coun. Sci. Industr. Res. Aust.*, 1946, **19**, No. 1, 128-139.

Insects and Diseases of the Pecan in Florida. By A. M. Phillips and J. R. Cole. *Bull. No. 411, Fla. Agric. Exp. Sta.* Pp. 62, 9 × 6. (Gainesville, Florida: Agricultural Experiment Station, 1945.)

Soil Preparations and Transplanting of Tomatoes. By C. N. Morgan. *Queensld. Agric. J.*, 1946, **62**, Pt. 6, 328-344.

The Soil and Cultural Requirements of the Tomato. By L. G. Vallance. *Queensld. Agric. J.*, 1946, **62**, Pt. 5, 261-270.

Bacterial Canker of Tomatoes in Kenya. By R. M. Nattrass and A. Ciccarone. *E. Afr. Agric. J.*, 1946, **12**, No. 1, 26-29.

Vegetables

Nutritive Value of Dehydrated Vegetables and Fruits. By P. L. Pavcek

and the Committee on Food Composition, National Research Council, U.S.A. *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 8, 853-856.

Fodders and Forage Plants

Birdsfoot Trefoil (*Lotus corniculatus* L.). Its Characteristics and Potentialities as a Forage Legume. By H. A. MacDonald. *Mem. No.* 261, *Cornell Univ. Agric. Exp. Sta.* Pp. 181, 9 × 6. (Cornell: Agricultural Experiment Station, 1946.)

The Nutritive Value of Cottonseed Meal, Soybean Meal and Peanut Meal when used separately and together to Supplement the Protein of Prairie Hay in Experiments with Steers. By H. M. Briggs, W. D. Gallup and A. E. Darlow. *J. Agric. Res.*, 1946, **73**, No. 5, 167-176.

Grasses and Grassland Management in the Caribbean. *Crop Inquiry Series No. 2, Caribb. Comm.* Pp. 68, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Hays and Hay Making in the Prairie Provinces. By M. J. Tinline. *Publ. No.* 722, *Dep. Agric. Canada.* Pp. 16, 9½ × 6. (Ottawa: King's Printer, 1946.)

Composition and Apparent Digestibility of the Carbohydrate and other Constituents of Pea and Lima-Bean Vines when Fed to Sheep. By M. Phillips, C. O. Miller and R. E. Davis. *J. Agric. Res.*, 1946, **73**, No. 5, 177-187.

Oils and Oil Seeds

Drying Oils from the British Empire. By G. T. Bray. *Oil. Col. Tr. J.*, 1946, **110**, No. 2503, 688, 690-692.

The Composition of the Oil Extracted from Fourteen Different Varieties of *Andropogon sorghum* var. *vulgaris*. By F. A. Kummerow. *Oil and Soap*, 1946, **23**, No. 9, 273-275.

Les Aleurites. By M. Angelbeen. *Bull. Agric. Congo Belge*, 1946, **37**, No. 2, 256-342. General article.

La Mécanisation de la Culture des Arachides. By L. Vertière. *Rev. Int. Prod. Colon.*, 1946, **21**, Nos. 200-201, 73-75.

Traitement des Arachides. By M. Vizern. *Bull. Inst. Colon. Marseille, Mat. Grasses*, 1946, **30**, Nos. 7-8, 103-116. An account of the decortication of groundnuts and the preparation of groundnut oil.

Nouvelles Utilisations de l' Huile de *Calophyllum inophyllum*. By A. Chevalier. *Rev. Bot. Appl.*, 1946, **26**, No. 283-284, 202-212.

Utilisation of Nim Oil and its Bitter Constituents (Nimbidin Series) in the Pharmaceutical Industry. *J. Sci. Industr. Res. India*, 1946, **6**, No. 1, 29-32.

L'Arbre à Beurre d'Afrique et l'Avenir de sa Culture. By A. Chevalier. *Oléagineaux*, 1946, **1**, No. 1, 7-11. Reviews the oil-bearing plants in Africa and deals especially with shea (*Butyrospermum parkii*).

Sesame. By D. E. Farringer. *Agric. in Americas*, 1946, **6**, No. 10, 160-163. General article.

Tall Oil. Its Origin, Composition, Processing and Uses in the Paint Industry. By M. Hess. *Paint Tech.*, 1946, **11**, No. 128, 299-304.

Fibres

The Production and Characteristics of the World's Cotton Crops. By E. Lord. *J. Text. Inst.*, 1946, **37**, No. 8, T151-T179.

Breeding Cotton Resistant to Blackarm Disease (*Bacterium malvacearum*). Part I. Introduction. By R. L. Knight. *Emp. J. Exp. Agric.*, 1946, **14**, No. 55, 153-160.

"Samaru 26C," a New Strain of Cotton Bred in Northern Nigeria. By W. E. Freeman. *Trop. Agric., Trin.*, 1946, **23**, No. 6, 109-113.

The Effect of Growth Substances on Fibre Flax Plants. I. An

Introduction to the Growth Substances and Their Effect on Germinating Flax Seed. II. The Influence of Growth Substances on the Mature Flax Plant. By D. A. Thorp. *Fibres*, 1946, **7**, No. 8, 215-218, No. 9, 263-266. Gives an account of certain research work carried out at H.M. Norfolk Flax Establishment.

Flax and Linseed Breeding in West Australia. Wada, a New Rust Resistant Flax Variety. By I. Thomas and A. J. Millington. *J. Agric. W. Aust.*, 1946, **23**, No. 1, 39-42.

Flax Rust in Western Australia. By W. P. Cass and H. L. Harvey. *J. Agric. W. Aust.*, 1946, **23**, No. 1, 42-45.

Paper-making Materials

Manufacture of Flax Pulp from Flax Fibre. By H. S. Spencer. *Pulp Pap. Mag. Canada*, 1946, **47**, No. 10, 95-97.

Experimental Sulphite Pulping of Eastern White Pine (*Pinus strobus* L.). By C. O. Skoggard and C. E. Libby. *Paper Tr. J.*, 1946, **123**, No. 4, 41-46.

Rubber

Rapid Photometric Methods of Determining Rubber and Resins in Guayule Tissue and Rubber in Crude-Rubber Products. By H. P. Traub. *Tech. Bull. No.* 920, *U.S. Dep. Agric.* Pp. 37, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 10 cents.

Drugs

The Suitability of a Number of Varieties of Opium Poppy for the Production of Morphine from the Ripe Capsule. By K. L. Hills. *J. Coun. Sci. Industr. Res. Aust.*, 1946, **19**, No. 2, 177-186.

Miscellaneous Agricultural Products

Recent Developments in Plastics in India. *J. Sci. Industr. Res. India*, 1946, **4**, 723-758. A number of articles on various aspects of the industry, including information on raw materials used and processes employed.

Livestock and Animal Products

Annual Report of the Veterinary Department, Nyasaland, for 1945. Pp. 4, 13 × 8. (Zomba: Government Printer, 1946.)

Survey of Animal Husbandry, Feeding, Management and Veterinary Services in the West Indies—Trinidad and Tobago. Report by W. C. Miller. *Bull. No.* 19, *Development and Welfare in the West Indies*. Pp. 40, 9 × 6. (Barbados: Advocate Company, 1946.) Price 10 cents.

Livestock in the Caribbean. *Crop Inquiry Series No.* 1, *Caribb. Comm.* Pp. 158, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

An Experimental Fishery Survey in Trinidad, Tobago and British Guiana, with Recommended Improvements in Methods and Gear. By R. T. Whiteleather and H. H. Brown. *Publ. Anglo-Amer. Caribb. Comm.* Pp. 130, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

The Fisheries of the Windward and Leeward Islands. Report by H. H. Brown. *Bull. No.* 20, *Development and Welfare in the West Indies*. Pp. 96, 9½ × 6. (Barbados: Advocate Co., Ltd., 1946.)

The Preparation of Skins for the Market. By P. D. Rose. Part I. Introduction: Slaughtering and Salting. Part II. Drying, Storing and Packing, *Frmg. S. Afr.*, 1946, **21**, No. 244, 433-442; No. 245, 523-530.

FORESTRY

General

Annual Report of the Forests Commission of Victoria for the year ended June 30, 1945. Pp. 35, 13 × 8. (Melbourne: Government Printer, 1945.)

Report on the Forest Department, British Guiana, for 1945. Pp. 7, 13 × 8. (Georgetown, Demerara: The *Daily Chronicle*, Ltd., 1946.)

Report of the Minister of Lands and Forests of the Province of Quebec for the year ended March 31, 1944. Pp. 157, 10 × 6¾. (Quebec: King's Printer, 1945.)

Annual Report of the Forestry Department, Nyasaland, for 1945. Pp. 16, 13 × 8. (Zomba: Government Printer, 1946.)

Report on the Forest Administration, Sierra Leone, for 1945. Pp. 14, 9¾ × 6. (Freetown: Government Printer, 1946.) Price 1*s*.

Report of the Conservator of Forests, Trinidad and Tobago, for 1945. Pp. 4, 13 × 8. (Trinidad: Government Printer, 1946.) Price 12 cents.

Annual Report of the Forest Department, Uganda, for 1945. Pp. 17, 9¾ × 6. (Entebbe: Government Printer, 1946.)

Spring Frosts. *Bull. No.* 18 (*2nd Edit.*) *For. Comm.* Pp. 111 + 11 plates, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 2*s*. 6*d*.

The Relation between Curing and Durability of *Bambusa tuldoides*. By D. G. White. *Caribb. For.*, 1946, **7**, No. 3, 253-267.

Timber

Annual Report on the Forest Department, British Guiana, for 1945. Pp. 7, 13 × 8. (Georgetown: Government Printer, 1946.)

Notes on British Guiana Timbers. By F. S. Danks. Pp. 28, 7 × 4¾. (Georgetown: Forest Department, 1945.)

Notes on Forty-Two Secondary Hardwood Timbers of British Honduras. *Bull. No.* 1, *For. Dep. Brit. Honduras.* Pp. 116, 8 × 6½. (Belize: Government Printer, 1946.)

L'Identification des Bois de la Côte d'Ivoire. By D. Normand. *Agron. Trop.*, 1946, Nos. 7-8, 361-374.

Las Maderas Cubanas. By A. J. Fors. Cubicacion de Piezas de Madera. By J. I. Corral. *Publ. Minist. Agric. Cuba.* Pp. 115, 9½ × 6. (Havana: Ministry of Agriculture, 1946.) Descriptions of the principal trees of Cuba and properties of the woods.

The Physical-Mechanical Properties of Certain West Indian Timbers, II. By R. W. Wellwood. *Caribb. For.*, 1946, **7**, No. 3, 191-228. Deals with motillo (*Sloanea berteriana*), a native timber of Puerto Rico and Haitian Pine (*Pinus occidentalis*).

Wood for Storage Battery Separators. By L. V. Peakes, R. A. Lloyd, V. S. Barnes, *et al.* *Industr. Engng. Chem., Industr. Ed.*, 1946, **38**, No. 8, 780-788.

Wood Preservatives. By N. A. Richardson. *Rec. No.* 17 (*Revised*), *For. Prod. Res., D. S. I. R.* Pp. 10, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 6*d*.

The Use of Chemically Treated Wooden Poles for Telephone and Power Transmission Lines in South Africa. By M. H. Scott. *J. S. Afr. For. Assoc.*, 1946, No. 13, 21-34.

Timber Preservation. Pp. 45, 7 × 4¾. (London: Timber Development Association, Ltd.)

IMPERIAL INSTITUTE

CONSULTATIVE COMMITTEE ON INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

QUARTERLY BIBLIOGRAPHY OF INSECTICIDE MATERIALS OF VEGETABLE ORIGIN, NO. 36

(July to September 1946)

Compiled by MISS R. M. JOHNSON.

With the collaboration of the Imperial Institute of Entomology and the Department of Insecticides and Fungicides, Rothamsted Experimental Station.

GENERAL

Biology and Control of the Ash Lace Bug, *Leptoypha minor*. By R. L. Usinger. *J. Econ. Ent.*, 1946, **39**, No. 3, 286-289. Various combinations of oil with nicotine, pyrethrum and rotenone were tried in control experiments; both nymphs and adults were completely controlled with a rotenone-oil mixture.

Further Toxicity Studies with the Dog Tick, *Dermacentor variabilis*. By A. H. Tauber, C. R. Joyce and O. E. Tauber. *Iowa St. Col. J. Sci.*, 1945, **19**, No. 4, 429-433. (*Exp. Sta. Rec.*, 1946, **94**, No. 4, 508.) Discusses the use of rotenone and nicotine.

Control of Aphids on Potatoes in North-eastern Maine. By T. E. Bronson and F. F. Smith. *J. Econ. Ent.*, 1946, **39**, No. 2, 189-194. DDT quite effective; a zinc nicotinyl fluosilicate dust and a nicotine sulphate spray also effective but derris inferior to DDT.

Some New Insecticides for Potato Insect Control. By G. G. Gyrisko. *J. Econ. Ent.*, 1946, **39**, No. 2, 262-263. A mixture of DDT isomers proved satisfactory against flea beetles and leafhoppers; preparations of pyrethrum and rotenone while giving good kills did not possess the lasting qualities of DDT and its related compounds.

An Evaluation of Various Sprays to Control Immature Squash Bugs. By T. C. Watkins. *J. Econ. Ent.*, 1946, **39**, No. 2, 225-261. Rotenone, pyrethrum and nicotine among the insecticides tested.

La Lutte contre l'Hoplocampe des Prunes (*Hoplocampa flava* L.) en Agenais. By F. Chaboussov and J. Lavaur. *C. R. Acad. Agric. France*, 1945, **31**, No. 2, 60-64. (*R.A.E.*, 1946, **34**, A, Pt. 8, 229.) Compares the effects of derris, quassia and nicotine sprays in dealing with this pest of plums.

DDT and Other New Insecticides for Control of Cauliflower Worms on Long Island. By H. C. Huckett. *J. Econ. Ent.*, 1946, **39**, No. 2, 184-188. The materials tested included cube, sabadilla, ryanex and an impregnated pyrethrin powder fortified by the addition of piperonyl cyclohexenone; none of these was so effective as DDT.

DDT to Control Potato Aphids. By G. G. Gyrisko, G. P. Wene and W. A. Rawlins. *J. Econ. Ent.*, 1946, **39**, No. 2, 205-208. Experiments showed DDT to be a better aphicide than such standard materials as rotenone and nicotine.

Untersuchungen über die Lauchmotte (*Acrolepia assectella*) und ihre Bekämpfung. By H. Siegrist. *Promotionsarb. Eidgen.-Tech. Hochsch. Zürich*, 1945. (*R.A.E.*, 1946, **34**, A, Pt. 7, 214-216.) In investigations on the leek moth sprays and dusts containing DDT or nicotine were tried, also a rotenone dust.

Effects of Atmospheric Environment, before and after Treatment, on the

Toxicity to Insects of Contact Poisons. I. By C. Potter and E. M. Gillham. *Ann. Appl. Biol.*, 1946, **33**, No. 2, 142-159.

Sprayers for Dispensing Concentrated Insecticides. By H. O. Schroeder and A. W. Lindquist. *Soap*, 1946, **22**, No. 6, 149-151, 173.

Factors Influencing the Interaction of Insecticidal Mists on Flying Insects. Part III. Biological Factors. By W. A. L. David and P. Bracey. *Bull. Ent. Res.*, 1946, **37**, Pt. 2, 177-189.

The Thermal Aerosol Fog Generator for Large Scale Application of DDT and Other Insecticides. By R. D. Glasgow and D. L. Collins. *J. Econ. Ent.*, 1946, **39**, No. 2, 227-235.

New Formulations of Aerosols Dispersed by Liquefied Gases. By E. R. McGovran, J. H. Fales and L. D. Goodhue. *J. Econ. Ent.*, 1946, **39**, No. 2, 216-219. Aerosol formulæ greatly improved in toxicity have been developed by increasing the non-volatile content and by adding sesame oil, piperonyl cyclohexenone (a synergist), DDT, benzene hexachloride and suitable solvents.

Controlling European Corn Borer and Ear Smut on Sweet Corn in the Home Garden. *Circ. No.* 487, *New Jersey Agric. Exp. Sta.* Derris or cube dust, or nicotine-bentonite were found most effective.

Some Recent Developments in Insecticides. By H. D. Tate. *Amer. Assoc. Cereal Chem. Trans.*, 1946, **4**, No. 2, 37-43. (*Exp. Sta. Rec.*, 1946, **94**, No. 6, 789.) The recent advances included in this summary relate to DDT, gammexane, repellents, new methods of application, thiocyanates, dinitro derivatives and sabadilla.

Testing of Roach Sprays. *Soap*, 1946, **22**, No. 7, 145-147.

ALKALOID-CONTAINING MATERIALS

Tobacco Products, including Nicotine and Nicotine Derivatives

Determining Nicotine Content. By Trautner and Neufeld. *Aust. Chem. Inst. J. Proc.*, 1946, **13**, No. 2, 73. (*Mfg. Chem.*, 1946, **17**, No. 8, 350.)

Adelges Cooleyi, an Insect Pest of Douglas Fir and Sitka Spruce. *Leafl. No.* 2 (*Revised*), *For. Comm.*, 1946. Nicotine emulsion recommended for remedial and control measures.

Eradication of Boxwood Leafminer and the Boxwood Psyllid. By L. Pyenson. *J. Econ. Ent.*, 1946, **39**, No. 2, 264. DDT gives excellent control of the leafminer with one application and nicotine sulphate of the psyllid.

The Leaf-Blister Sawfly (*Phylacteophaga eucalypti*). *Agric. Gaz. N.S.W.*, 1946, **57**, Pt. 4, 198-199. Control of the larvae may be obtained by spraying with nicotine sulphate.

Experiences with Additives to Lead Arsenate in Codling Moth Control. By H. M. Steiner. *Proc. N. Y. St. Hort. Soc.*, 1945, **90**, 195-207. (*R. A.E.*, 1946, **34**, A, Pt. 7, 196-197.) Discusses the use of nicotine.

A Machine for Nicotine Fumigation of Field Plots. By A. R. Wilson. *Bull. Ent. Res.*, 1946, **37**, Pt. 2, 281-290.

Nicotine Sulphate from Nyasaland. *Chem. Tr. J.*, 1946, **119**, No. 3091, 204. January-April, 1946, exports value of £3,156; those for similar period 1945, £947.

Tanganyikan Tung Oil and Nicotine. *Chem. Tr. J.*, 1946, **119**, No. 3094, 294. Nicotine sulphate valued at £4,419 exported from Tanganyika, January-May, 1946.

High Nicotine Content Tobacco, Kigezi [Uganda]. *Ann. Rep. Dep. Agric. Uganda*, 1944-45, Pt. 1, p. 19. Small industry for the production of nicotine sulphate expanding satisfactorily.

Nicotine in South Africa. *Chem. Tr. J.*, 1946, **119**, No. 3087, 84. The production of nicotine from South African grown tobacco considered not feasible.

Cytotaxonomy of *Nicotiana*. By T. H. Goodspeed. *Bot. Rev.*, 1945, **11**, No. 10, 533-592. (*Exp. Sta. Rec.*, 1946, **94**, No. 5, 608.)

Studies in Nicotiana—III. A Taxonomic Organisation of the Genus.

By T. H. Goodspeed. *Calif. Univ. Pub. Bot.*, 1945, **18**, No. 15, 335-343. (*Exp. Sta. Rec.*, 1946, **94**, No. 6, 744.)

INSECTICIDE MATERIALS CONTAINING ROTENONE AND ALLIED SUBSTANCES

General

The Control of Spittle Insects in Strawberry Plantings. By F. G. Mundinger. *J. Econ. Ent.*, 1946, **39**, No. 3, 299-305. Rotenone a specific for this insect.

Effect of Mineral Composition and Particle Size in Dispersants on Toxicity of Rotenone Dusts. By H. F. Wilson and M. L. Jackson. *J. Econ. Ent.*, 1946, **39**, No. 3, 290-295.

Ann. Rep. Dep. Agric. N.S. Wales, 1944-45, p. 26. In tests to control the potato moth DDT was found more effective than rotenone.

Rotenone-containing Insecticide. U.S. Pat. No. 2,369,855. Contains rotenone-bearing root, wood flour of *Pseudotsuga taxifolia* which it is claimed acts as a synergist, and petroleum distillate.

Application of a Modified Red-Color Test for Rotenone and Related Compounds. By M. A. Jones. *J. Assoc. Off. Agric. Chem.*, 1945, **28**, No. 2, 352-359.

New Rotenone Insecticides. *Soap*, 1946, **22**, No. 6, 185. A series of insecticides containing hydrogenated rotenone as their active principle.

Basic Copper Sulphate in Combination with Rotenone for the Control of Diseases and Insects of Potatoes. *Ann. Rep. Univ. Maine Agric. Exp. Sta.*, 1943-44, p. 238.

The Mexican Bean Beetle. By B. B. Pepper. *Circ. No.* 495, *New Jersey Agric. Exp. Sta.* Rotenone or derris recommended for its control.

Bull. No. 431, *Univ. Maine Agric. Exp. Sta.*, 1944. Discusses insecticides for Mexican bean beetle control, calcium arsenate and rotenone, the amount of insecticides required and their application, pp. 216-220.

Derris

The Lack of Scion Effect on Root Quality of *Derris elliptica*. By M. A. Jones and W. C. Cooper. *Plant Physiol.*, 1946, **21**, No. 1, 102-108. (*Exp. Sta. Rec.*, 1946, **94**, No. 6, 763.)

A Comparison of Three Varieties of *Derris elliptica*. By M. A. Jones and C. Pagan. *Trop. Agric., Trin.*, 1946, **23**, No. 4, 76-80. Experiments carried out in Puerto Rico with Sarawak Creeping, Changi No. 3 and St. Croix.

Evaluation of Some Clones of *Derris elliptica*. By M. A. Jones, D. G. White and C. Pagan. *Trop. Agric., Trin.*, 1946, **23**, No. 5, 89-93.

Derris and Allied Insecticides. By W. M. Seaber. *Fertil. Feed. Stuffs J.*, 1946, **32**, No. 2, 43-46. (*Amer. Chem. Absts.*, 1946, **40**, No. 9, 2584.) Gives particulars of the ether extract and rotenone contents of various sources of rotenone.

A Toxicological Comparison of Derris and Lonchocarpus. By M. A. Jones, W. A. Gersdorff and E. R. McGovran. *J. Econ. Ent.*, 1946, **39**, No. 3, 281-283.

Tobacco Pest and Its Control. By F. Burke. *Industr. Chem.*, 1946, **22**, No. 259, 476. Derris mentioned as being highly toxic to adults of *Lasioderma serricorne*.

Control of the Nuche Fly and Cattle Tick. By R. L. Squibb. *J. Animal Sci.*, 1945, **4**, 291-296. (*Brit. Absts.*, 1946, BIII, July, 162.) Washing the animals with derris extract did not completely eliminate the larvae of *Dermatobia hominis*.

Diatomaceous Diluents for Dusts. By N. Turner. *J. Econ. Ent.*, 1946, **39**, No. 2, 149-158. Fifteen samples were studied as diluents for ground derris root in the laboratory.

Programme of Social and Economic Development in the Zanzibar Protectorate for the Ten Year Period 1946-1955. *Sess. Pap.* No. 1 of 1946 p. 9. Derris to be grown as a subsidiary cash crop either for export or for use locally in connection with vegetable production.

Cube

Flowering of Peruvian Cube (*Lonchocarpus utilis* A. C. Smith) induced by Girdling. By W. C. Cooper, A. L. Burkett and A. Herr. *Amer. J. Bot.*, 1945, **32**, No. 10, 655-657. (*Exp. Sta. Rec.*, 1946, **94**, No. 5, 607.)

Others

Tephrosia noctiflora as an Insecticide Plant. By A. Mutinelli. *Rev. Argentina Agron.*, 1945, **12**, 291-314. (*Amer. Chem. Absts.*, 1946, **40**, No. 14, 4170.)

PYRETHRIN-CONTAINING MATERIALS

Pyrethrin I Determination. The Effect of Light in Causing Variations in Experimental Results. By N. Green and R. H. Carter. *Soap*, 1946, **22**, No. 7, 148A-148C.

Report on Some Miscellaneous Methylenedioxyphenyl Compounds Tested for Synergism with Pyrethrum in Fly Sprays. By E. A. Prill and M. E. Synerholm. *Contrib. Boyce Thompson Inst.*, 1946, **14**, No. 4, 221-227. Sixty-nine compounds of various types were tested in solution with a low concentration of added pyrethrins; the presence of a methylenedioxyphenyl group is not a sufficient condition for insecticidal activity or for synergistic activity with pyrethrum.

Biology and Control of the American Dog Tick. By C. N. Smith, M. M. Cole and H. K. Gouck. *Tech. Bull. No.* 905, *U.S. Dep. Agric.*, 1946. Derris dip found satisfactory for control of the ticks on dogs; DDT spray used for dealing with those concentrated on road sides, etc.

Roach Powder Tests. By E. R. McGovran and P. G. Piquett. *Soap*, 1946, **22**, No. 8, 157, 159, 181. Pyrethrum tested.

Control of the American Dog Tick, a Vector of Rocky Mountain Spotted Fever. Preliminary Tests. By R. D. Glasgow and D. L. Collins. *J. Econ. Ent.*, 1946, **39**, No. 2, 235-240. Describes tests with DDT alone and in combination with pyrethrum.

New Concentrates Produce Superior Household Sprays. *Soap*, 1946, **22**, No. 8, 78A. A new chemical developed to augment straight pyrethrins which is a close relative to the already well-known piperonyl cyclohexenone.

Controlling Corn Ear Worm. *Down to Earth*, 1945, **1**, No. 1, 13-14. Solution of styrene dibromide used as a substitute for pyrethrum.

Insecticidal Preparations for Use in Buildings. Brit. Pat. No. 577,124. *Brit. Absts.*, 1946, BIII, August, 188. Contains lethane and pyrethrum.

Repellency of Pyrethrum and Lethane Sprays to Mosquitos. By C. R. Ribbands. *Bull. Ent. Res.*, 1946, **37**, Pt. 2, 163-172.

Observations on Tick Repellents. By C. N. Smith and H. K. Gouck. *J. Econ. Ent.*, 1946, **39**, No. 3, 374-378. Pyrethrum some use.

Brazilian Pyrethrum Crop. *Chem. and Drugg.*, 1946, **146**, No. 3469, 155. Estimated at 2,000 tons.

Peruvian Pyrethrum Plans. *Chem. Tr. J.*, 1946, **119**, No. 3097, 381. Peruvian Government has established a "floor" price for home produced pyrethrum.

OTHER INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

Insecticidal Properties of the Indigobush (*Amorpha fruticosa*). By C. H. Brett. *J. Agric. Res.*, 1946, **73**, No. 3, 81-96.

Preliminary Experiments with *Amorpha fruticosa* on Cattle Grubs. By

H. I. Featherly and K. S. Harmon. *J. Amer. Vet. Med. Assoc.*, 1944, **105**, 291-293. (*Vet. Bull.*, 1946, **16**, No. 3, 83.)

Gossypol and Its Possible Uses. By K. S. Murty and T. R. Seshadri. *Indian J. Pharm.*, 1942, **4**, 153-157, 163. (*Amer. Chem. Absts.*, 1946, **40**, No. 11, 3219.) Certain preparations are effective against white ants and bugs.

Insecticidal Mixture of Yam Bean (*Pachyrhizus* spp.). Toxicants and Pyrethrins. U.S. Pat. No. 2,383,304. *Pharm. Absts.*, 1946, **12**, No. 6, 173, in *J. Amer. Pharm. Assoc.*, 1946, **35**, No. 6.

Plant Insecticide. U.S. Pat. No. 2,388,393. *Amer. Chem. Absts.*, 1946, **40**, No. 12, 3558. The plant *Pycnothymus rigidus* is claimed to be an effective insecticide and activator for other insecticides.

DDT and Ryanex to Control Oriental Fruit Moth: Their Effect Upon Parasite Populations. By E. H. Wheeler and A. A. La Plante. *J. Econ. Ent.*, 1946, **39**, No. 2, 211-215. DDT and ryanex were compared with each other. DDT greatly reduced the number of twig-infesting larvae and also the rate of parasitism; ryanex had a comparable effect for a shorter period and did not exhibit the residual action of DDT.

Sabadilla and DDT to Control the Squash Bug. By R. R. Walton. *J. Econ. Ent.*, 1946, **39**, No. 2, 273. Experiments showed that if plants are thoroughly dusted control can be obtained with dusts containing as low as 5 per cent. sabadilla; DDT was less effective on the larger nymphs and adults during a period of 64 to 72 hours after treatment but over a longer period of time continues to kill the bugs and ultimately establishes effective control.

Sabadilla as an Insecticide. *Bull. Imp. Inst.*, 1946, **44**, No. 2, 102-104.

New Insecticides Give Promise for Control of Lygus Bugs in Alfalfa Grown for Seed. By C. J. Sorenson and J. W. Carlson. *Farm. Home Sci. Utah*, 1945, **6**, No. 3, 5-11. (*Exp. Sta. Rec.*, 1946, **94**, No. 4, 501.) DDT at rate of 10 per cent. gave best control while DDT 3 per cent. and sabadilla 10 per cent. ranked second and third respectively.

Sabadilla and DDT to Control the Hairy Chinch Bug. By R. S. Filmer and C. L. Smith. *J. Econ. Ent.*, 1946, **39**, No. 3 309-313.

Insecticide from Sabadilla Seed. U.S. Pat. No. 2,390,911. *Amer. Chem. Absts.*, 1946, **40**, No. 7, 1964.

Insecticidal Value of Vegetable Oils in Combating the San José Scale (*Quadraspidiotus perniciosus* Comst.) By G. Viel. *Compt. Rend.*, 1945, **221**, 589-590. (*Amer. Chem. Absts.*, 1946, **40**, No. 11, 3218.) Peanut oil more active than other vegetable oils.

MINERAL RESOURCES

ARTICLES

WAR-TIME DEVELOPMENT OF SCOTTISH MICA DEPOSITS

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Preliminary investigations into the possibility of working mica-bearing pegmatites in the West Highlands of Scotland were commenced in the autumn of 1942, when the attention of the Ministry of Supply had been called to a promising occurrence on the south ridge of Sgurr Coire nan Gobher at Knoydart, Loch Nevis, Inverness-shire, discovered by the Scottish Geological Survey in 1938, and to another at Dalilea near Acharacle, Loch Sheil, Inverness-shire, by Mr. A. B. Mudie of the Eastern Mica Co., Ltd., Arbroath. Some trials at Knoydart produced samples which were examined by the Mica Control and by the National Physical Laboratory. The reports being favourable, it was decided to open up the Knoydart deposit when the weather became favourable in the following spring, and also to embark on a systematic exploratory programme for other occurrences suitable for rapid war-time development.

It was appreciated that any developments which proved possible were unlikely to be economic since, quite apart from the apparent relatively low-grade nature of the deposits as compared with, for instance, the well-known mica occurrences of the Indian producing fields, the Scottish localities (that at Knoydart in particular) were relatively inaccessible, mining costs would be high and labour was in short supply; furthermore, working on the higher ground would not be possible during the winter months. Nevertheless, the Knoydart occurrence had been shown to yield high quality strategic mica in categories which were in critically short supply for urgent war requirements, and the need of even small quantities of block mica in these categories, especially from domestic sources, was a sufficient justification for the project at that time.

In May 1943, by arrangement with Brocket Estates, Ltd., the Knoydart occurrence was opened up. As the mica-bearing pegmatites outcropped at an elevation of around 2,000 ft. above Loch Nevis it was necessary to build living quarters for the men on the site, and material for the huts, mining equipment (including compressor), stores, food, etc., all had to be man-handled from the loch shore, to which it was transported by motor launch from Mallaig, 10 miles

distant, where the nearest road and rail-head are situated. In this essential preliminary work, and later in the year when a rough pony track was constructed for a distance of about two miles up the mountain side, the Company received invaluable voluntary assistance from contingents of the Royal Canadian Engineers, and also from British Army units training in the area. A small jetty was built on the loch shore, with an adjoining hut for stores and for the rough dressing of mica before shipment.

At first, one quarry only was worked on the original pegmatite noted by the Geological Survey, but later other mica-bearing pegmatites were discovered in the vicinity and before operations ceased in 1944 five quarries had been opened. None of the later quarries was as successful as the first, which was eventually developed into four benches; the mica zone in this pegmatite was about 3 ft. wide and had a proved length of 250 ft. The bulk of the production (52,000 lb. crude mica) came from this quarry.

Concurrently with the development at Knoydart, the Geological Survey started an intensive search for new mica deposits in the Highlands, and in particular, on their recommendation, occurrences at the following localities were further investigated and some tested by the Company:

1. Acharacle and Loch Sheil.
2. Ben Resipol.
3. Ardarie (Loch Sheil).
4. Kinlochquoich.
5. Glenfinnan.
6. Strathpeffer and Garve districts:
    (*a*) Little Scatwell.
    (*b*) Carn Gorm.
    (*c*) Brae Tollie.

Nos. 1 to 5 were rejected for war-time development as their prospects compared unfavourably with those of Knoydart. For similar reasons the Dalilea occurrence, where a trial was already being made by Mr. Mudie, was also rejected.

Localities in the Strathpeffer and Garve districts, Ross-shire, showed more promise and on the recommendation of the Geological Survey extensive trials were made in the summer of 1943 at Carn Gorm (about 3¾ miles W. 32°N. of Auchterneed Station) and at Brae Tollie (in the valley of the Tollie Burn, about 5½ miles N.W. by N. of Alness Station). Both these occurrences were worked for a short period and yielded a small production of good quality block mica. Later in the summer they were both closed in favour of a new occurrence suggested by the Geological Survey for trial and situated at Little Scatwell. Preliminary trials indicated that this occurrence had prospects of being quickly developed on a relatively large scale; furthermore, it had the added advantage of being situated at a comparatively low elevation and it was therefore

possible to work throughout the winter. A local contractor (Messrs. Duncan Logan of Dingwall) was engaged and the project equipped for production in September 1943. Work was carried out by arrangement with Mr. Hugh Matheson, the owner of the property.

The mica occurrence at Little Scatwell consists of at least seven mica-bearing pegmatites lying within a relatively narrow zone. Several of these were opened up and quarries situated on three reached a high level of production. As operations proceeded, however, it was found that the yield of block mica, both in quality and grade, did not, on the average, approach that of Knoydart. In addition, the mica was found to be rather softer in comparison with the general run of Knoydart production. Later in the autumn of 1943, when conditions became unsuitable at Knoydart, Messrs. Keir and Cawder, the contractors, together with their labour force, were transferred to Little Scatwell and production there continued until the spring of 1944.

All available labour was concentrated at Knoydart during the summer of 1944 and operations continued until October 1944, when the project was closed.

The Little Scatwell occurrence yielded approximately 180,000 lb. of run-of-mine mica, from which was produced approximately 3,670 lb. of saleable block mica.

The trials at Carn Gorm and Brae Tollie, together with other exploratory works for new deposits during the summer of 1943 and the winter of 1943-44, were continued in association with the Geological Survey, the exploratory programme, so far as the Company was concerned, being under the supervision of Mr. Gordon Duncan, of Messrs. Wilkens and Devereux, Consultant for Scotland to the Non-Ferrous Mineral Development Control, Ministry of Supply. The production arrangements at Knoydart and Little Scatwell were in charge of Mr. James Jackson, Engineer to the Control, with Mr. J. M. Stowell as local Manager.

When production first commenced, rough dressing stations were started at the lochside at Knoydart, and at Blairninich, near Strathpeffer, for the Carn Gorm, Brae Tollie, and Little Scatwell production, where the crude books of mica, as mined, were rough dressed, trimmed and sorted before despatch to the main sorting factory at Pitlochry in Perthshire. Later it was found more practicable to have the whole of the rough dressing operations in the charge of skilled personnel at the latter sorting factory. The Knoydart production was brought down the hillside by pony, carried by launch to Mallaig and thence by rail to Rannoch. At Rannoch it was sent by bus to Pitlochry. Production from Little Scatwell was transported direct by rail to Pitlochry *via* Inverness.

Pitlochry Sorting Factory

The main sorting factory at Pitlochry was opened in August 1943 with a staff of six, for the first few weeks under the direction

of Mr. A. B. Mudie of the Eastern Mica Co., Ltd. and later under Mrs. D. G. Readdie. In November 1943, additional premises were acquired and the staff increased to 36.

The preparation of saleable block mica is highly specialised. All the workers employed at the sorting factory were young girls recruited locally and it was possible to judge within a few days whether a girl could adapt herself to the work, but even then it took many weeks before a girl was fully trained.

The equipment used is of a simple nature, consisting of various types of knives, each used for a distinct and separate purpose. Having mastered the technique of cutting quickly and cleanly, the next step is for the trainee to learn how to extract the largest possible plate with a minimum of waste, how and when to remove interlaminar stains by splitting, and how to remove damaged films from the surface of the block as thinly as possible. The amount of block mica which a trained operative can produce daily varies considerably with the size and general characteristics of the mica, and ranges from 4½ lb. for the small sizes up to 16 lb. for the larger grades.

Mica is extracted in the form of books or blocks, which are split down into plates averaging about 20 mils in thickness, the plates being trimmed from the book to include the largest possible useable area with the exclusion of cracks and such imperfections as may spoil the mechanical or electrical properties of the mica.

The first operation, known as rough dressing, consists of splitting the books into sheets, roughly 30 mils in thickness, and cutting away the flaws, incrustations, striations, etc. The rough dressed mica is then passed to the cutters, who carefully remove all remaining flaws and trim the edges, leaving block mica of irregular shape, having a curved and indented outline. At this stage, the mica is usually split again to remove interlaminar spots and stains, a process which needs care and judgment by the operative, who must be able to see between which layers the stains occur and decide whether the loss of weight incurred by the removal of stained or dotted laminae is compensated by the improved quality obtained. The finished block mica is then graded for size, the grade being determined not by the area of the plate, but by the area of the largest rectangle which can be obtained from it.

The principal factors which determine the quality of block mica are clearness, hardness and flatness. Air spots, mineral and vegetable spots and lines, softness and waviness impair the electrical properties and mechanical strength of the mica, and it is the extent to which these faults occur that determines in which category a block should be placed.

The mica from the Strathpeffer area was of a greenish ruby colour, comparatively free from metallic stains, but generally containing vegetable inclusions and dense air inclusions, and thus very little of the output was above " stained " quality. The mica

from the Knoydart area was, for the most part, brownish ruby in colour, hard, substantially flat, and glossy in appearance. A small proportion contained light vegetable stains and mineral dots, but the entire output proved to be of strategic quality, that is, "stained" and better. Towards the close of operations, a small quantity of green mica was produced at this locality.

The block mica, having been graded and qualified, was despatched to London in wooden packing cases, each containing about 50 lb. of mineral packed in layers with the edges overlapping to prevent damage in transit.

Concurrently with the production of block mica, scrap mica suitable only for grinding was produced, and this was consigned from the sorting factory under four categories:

(a) Mica books, as received from the mine, and unfit for processing.
(b) Sheets of mica split from the book during the rough dressing process, but too badly cracked or striated for inclusion with the block mica.
(c) Small pieces cut from the rifted sheets during rough dressing.
(d) Trimmings produced during the cutting process.

The mica produced and processed in Scotland was accepted by the Government inspectors, and the manufacturers who used it declared it to be equal to that imported from India and elsewhere.

Production from the Pitlochry factory totalled 7,122 lb. of block mica, divided approximately equally between Knoydart and Little Scatwell. In addition, about 85 tons of scrap mica, resulting from the dressing operations, was sold.

Production data regarding crude mica are as follows:

	Rock quarried (*Tons*)	Crude mica produced (*Lb.*)	Crude mica yield (*Lb./ton*)	(%)
Knoydart	3,606	74,606	20·69	0·92
Little Scatwell	7,079	117,778	16·6	0·74
Total	10,685	192,384	18	0·8

The author is indebted to Sir William Larke, K.B.E., Chairman, Non-Ferrous Minerals Development, Ltd., and to the Ministry of Supply for permission to publish this record of the Scottish mica project. The record would be incomplete also without reference to the names of those individuals who were chiefly responsible for the work in the field, through their association with the Company, the Ministry of Supply, or the Scottish Geological Survey, namely, Mr. James Jackson, Mr. J. S. Stowell, Mrs. K. Readdie, and Mr. A. B. Mudie; Mr. Gordon S. Duncan, Mr. D. G. Readdie; Professor W. Q. Kennedy, Dr. Richey and Dr. T. Robertson; and the Staff of Messrs. Keir and Cawder, Ltd. Details with regard to sorting and dressing were kindly supplied by Mrs. Readdie.

THE GEOLOGY OF THE NAMWELE-MKOMOLO COALFIELD, UFIPA DISTRICT: WITH NOTES ON UNDERGROUND EXPLORATION CARRIED OUT BY THE TANGANYIKA GOVERNMENT[1]

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THE following Appendices record the factual data and conclusions arrived at from a series of comprehensive technical tests carried out on coal samples from the Namwele-Mkomolo Coalfield. Appendix I sets out the results obtained by the Imperial Institute, and evaluates the coal deposits in general (*see* especially pp. 339-340). Appendix II gives the detailed results of coal analyses and beneficiation tests carried out by the Department of Lands and Mines, Tanganyika Territory, prior to the work summarised in Appendix I; its general conclusions (*see* p. 353) should therefore be read accordingly. Appendix III is a résumé of a report by the Chief Mechanical Engineer of the Tanganyika Railways, and deals with the important subject of railway steaming tests. The Appendices conclude with a short note (Appendix IV) by the late Mr. F. Oates on the hydraulic limestones and marls of the district investigated.

The results show that the coal is a non-caking bituminous coal with high volatile, ash and sulphur contents, the ash having a comparatively low fusion temperature. In addition to the samples here described, four series of samples (17 in all) were taken from the carbonaceous measures below the main coal which, however, proved to be valueless.

APPENDIX I

Evaluation of the Coal Deposits at Namwele

By The Imperial Institute, London

In connection with the proposal to utilise the deposits of bituminous coal occurring in the Ufipa district of Tanganyika (*see* Location Plan, Pl. I), the main section of the deposit was opened up at Namwele during 1943 to investigate its nature and extent. Four shafts were sunk and samples were taken over a fairly wide area (*see* p. 235). A large number of seam sections and strata samples have been examined locally, but, in amplification of this work, channel samples representing the full depth of the best coal were taken at six different points, as indicated on page 236 and in the following list, and forwarded to the Imperial Institute for assessment of their industrial value in the Territory.

[1] Concluded from p. 251 of BULLETIN No. 3, 1946, which contains relevant maps and illustrations.

Shaft No. 1

Sample No.	*Where taken.*
1.	At 27 ft. in the 100 ft. sub-level S.E., 100 ft. down No. 1 inclined shaft below First Level, and about 210 ft. vertically from the surface.
2.	At 28 ft. in No. 2 Level S.E., 200 ft. down No. 1 inclined shaft below First Level, and about 260 ft. vertically from the surface.
3.	At 27 ft. in the 300 ft. sub-level S.E., 300 ft. down No. 1 inclined shaft below First Level, and about 300 ft. vertically from the surface.
4.	From the S.E. wall of No. 1 inclined shaft, at 460 ft. down the incline from First Level, and about 370 ft. vertically from the surface.

Shaft No. 4

Sample No.	*Where taken.*
5.	From S.E. wall of inclined shaft, at 376 ft. down the incline from the surface, and about 230 ft. vertically from the surface.
6.	From S.E. wall of inclined shaft, at 480 ft. down the incline from the surface, and about 270 ft. vertically from the surface.

Each of the six samples consists of the material removed in making a channel perpendicular to the bedding, 50 in. long by 6 in. wide by 6 in. deep; the roof shale or "shale marker" was taken in each case as the top of the channel so that the 50-in. sample is representative of the best coal. The six samples represent approximately the same coal horizon and show the variations throughout the workings.

Measurements of the strata composing the face from which each sample was cut are as follows:

FACE SECTIONS FROM WHERE SAMPLES WERE OBTAINED[1]
(Thicknesses expressed in inches.)

Shaft No. 1

Sample No. 1

COAL	4¼
Dark grey carbonaceous shale	2¼
COAL	5½
Carbonaceous shale	½
COAL, good	19
Carbonaceous-and coal-shale	3½
COAL, shaly	7
Carbonaceous shale	8
COAL, rather shaly	5
Carbonaceous shale	5+

Sample No. 2

COAL	4
Carbonaceous shale	1¾
COAL	6¼
Carbonaceous shale	2½
COAL, a bit shaly in parts	10
Shale	2½
COAL	5½
Carbonaceous shale	3
Coal-shale	3½
COAL	6
Carbonaceous shale	1½
COAL	1
Carbonaceous shale	2½
COAL, shaly	2
Carbonaceous shale	1
COAL	3
Dark carbonaceous shale	2+

Sample No. 3

COAL	4
Dark carbonaceous shaly mudstone	3
COAL	6
Carbonaceous shale	1½

Sample No. 4

COAL, a bit shattered	4
Dark carbonaceous shale	2½
COAL, hard	6½
Crushed coal-shale	6
COAL, rather shattered in parts	14

1 The top of each face section is composed of "roof shale," which is a micaceous, carbonaceous, shaly, grey mudstone. In sections Nos. 1-4, some secondary pyrite has formed as thin veins following the cleat. In shaft No. 4, all coal contains pyrite in numerous small lenses and veins.

Shaft No. 1—(continued)

Sample No. 3

COAL, hard	14
Carbonaceous shale	2½
COAL, hard	18
Carbonaceous shale	1
COAL, shaly	4+

Sample No. 4

Coal-shale	2
COAL, rather friable	8
Coal-shale	3
Dark carbonaceous shale	12

Shaft No. 4

Sample No. 5

COAL, crushed	½
COAL, crushed near top	5½
Soft carbonaceous shale	1½
COAL, a bit friable	14½
Crushed coal-shale	3
COAL, a bit friable	16½
Grey carbonaceous, micaceous mudstone	3
COAL	4½
COAL, shaly	1
COAL, crushed	1½
Carbonaceous shale	2½

Sample No. 6

Dark carbonaceous gouge	1
COAL, a bit crushed	6
Crushed carbonaceous shale	2
COAL, a bit friable	14½
Grey compact mudstone	4½
COAL	7
Carbonaceous shale	7
COAL, shaly	5
Coal-shale	3
COAL	2
Carbonaceous shale	2+

The bulk sample was, in each case, crushed to a maximum size of 1 in. and reduced in quantity by normal sampling methods, leaving sufficient to fill two 4-gallon petrol tins which were rendered airtight and packed in a reinforced crate for shipping. On receipt at the Imperial Institute, the samples were screened, although, in view of the preliminary crushing, the screen analysis was of little significance. Analyses, calorific values and distillation tests were carried out, and the results are set out in Table I. To facilitate comparison of the actual coal substance, the important data are also re-calculated to a dry ash-free basis. With coals of this type such figures are comparative only, as exact corrections cannot be made owing to the high ash content.

An appreciation of the character of the coal is best obtained from the ultimate analysis calculated to a mineral-free basis. This was done on pure coal carefully separated from sample No. 6, the analysis being as follows:

Ultimate Analysis (Sample No. 6)
(Mineral-free basis)

	Per cent.
Carbon	79·8
Hydrogen	5·2
Nitrogen	1·6
Sulphur	2·2
Oxygen	11·2

The above analysis is that of a bituminous coal of the lignitous type. Such coals, having an oxygen content in excess of 10 per cent. normally have only slight caking power,[1] and in the present instance it is only just perceptible.

In general appearance, specimens of the clean coal are black and

[1] *See* The "Caking" of Coal, by J. G. King; *Fuel in Science and Practice*, 1944, **23**, No. 3, pp. 61-64.

shiny; they are fairly strong and hard, but so markedly intergrown with mineral bands and disseminated inorganic matter that most pieces have a greyish, dirty appearance. Consequently it did not seem likely that the coal would have a high value as a fuel or respond to attempts at cleaning aimed at producing a fuel of low ash content. Moreover, if it were decided to attempt carbonisation in order to produce a liquid product such as tar, the coke would have a proportionally higher ash content. Although this product would provide a smokeless fuel, it would be limited in its use by this high ash content. Nevertheless, it was decided to examine the possibility of cleaning the coal to a more reasonable ash content.

TABLE I.—ANALYSES OF NAMWELE COALS

		Sample No.					
		1	2	3	4	5	6
Screening Analysis (air-dried material)							
Over 1 in.	*per cent.*	10·2	6·4	0·3	0·4	0·2	1·5
1 in. to ½ in.	,,	14·7	20·0	16·1	7·3	12·1	10·3
½ in. to ¼ in.	,,	19·6	20·1	21·0	24·1	21·7	22·4
¼ in. to ⅛ in.	,,	30·1	30·6	33·4	36·5	34·0	36·6
⅛ in. to 1 mm.	,,	14·2	12·8	14·0	17·5	16·2	16·4
Less than 1 mm.	,,	11·2	10·1	15·2	14·2	15·8	12·8
Proximate Analysis							
Air-dried coal							
Moisture	,,	5·5	5·3	4·3	4·3	6·1	3·7
Volatile matter less moisture	,,	25·9	26·0	28·6	27·0	29·0	20·5
"Fixed carbon"	,,	30·9	27·4	34·4	29·2	35·2	23·5
Ash	,,	37·7	41·3	32·7	39·5	29·7	52·3
Volatile matter in dry ash-free coal	,,	45·6	48·7	45·4	48·1	45·1	46·6
Calorific Value							
Air-dried coal	*cal./gm.*	4,260	3,550	4,520	4,000	4,756	2,900
	B.Th.U./lb.	7,668	6,390	8,136	7,200	8,561	5,220
Dry ash-free coal	*cal./gm.*	7,500	6,650	7,180	7,120	7,410	6,590
Laboratory Carbonisation Assay at 600° C. (Gray-King Apparatus)							
(*a*) *Yield per 100 gm. air-dried coal*							
Coke	*gm.*	73·50	75·00	74·50	74·95	72·30	80·75
Tar	,,	7·85	5·00	9·10	7·70	8·50	5·70
Liquor	,,	10·50	11·00	9·00	9·50	11·10	8·50
Gas	*ml.*	7,490	6,500	7,500	7,400	7,880	5,030
(*b*) *Calculated yields per ton air-dried coal*							
Coke	*cwt.*	14·70	15·00	14·90	14·99	14·46	16·15
Tar	*gal.*	17·55	11·18	20·20	17·21	19·00	12·75
Liquor	,,	23·5	24·6	20·1	21·2	24·8	19·0
Gas	*cu. ft.*	2,680	2,330	2,690	2,650	2,820	1,810
*Character of Coke**	*Type*	A	A	B	B	B	A
Behaviour on Distillation							
First appearance of oil vapour	*deg. C.*	440	410	415	400	405	420
Start of evolution of gas	,,	410	415	410	410	410	415

* Coke Type A = Pulverulent; Coke Type B = Just coherent, breaks into powder on handling. *See* Standard descriptions of coke given in "Methods of Analysis of Coal and Coke"; *Fuel Research Survey Paper No.* 44, 1940, p. 62.

Coal Cleaning

In order to examine the washing characteristics of the Namwele coal, and to determine the feasibility of producing a product with a more reasonable ash content, float and sink analyses were made on crushed material from each of the three sizes, namely, ⅝ in. to ⅜ in.; ⅜ in. to ⅛ in.; ⅛ in. to 1 mm. The standard method used was that of floating the coal successively in liquids of relatively high specific gravities, starting where expedient at 1·30 and increasing in steps of 0·05 to 1·80, the liquids being toluene, carbon tetrachloride and bromoform. The results of these experiments are illustrated graphically in Pl. VIII by a series of washability curves known as the "Observed Curve," the "Floatings Curve" and the "Sinkings Curve."

Construction of Coal Washability Curves

As these curves are more instructive than the mere tabulation of the actual float and sink analyses upon which they are based, an example is given showing the method of their construction. For this purpose, graph No. 3, representing sample No. 1, size ⅛ in. to 1 mm. is reproduced below in greater detail (Fig. 1), together with the relevant experimental data.

Float and Sink Test on Coal from Namwele
(Data for construction of Fig. 1.)
Size: ⅛ in. to 1 mm.

I Sp. Gr.	II Weight of Raw Coal. (*Per cent.*)	III Cumulative Weight of Coal. (*Per cent.*)	IV Average Ash of Fraction. (*Per cent.*)	V Cumulative Weight to Middle of Fraction. (*Per cent.*)	VI Ash Content of Combined Fractions. (*Per cent.*)	VII Cumulative Sinks. (*Per cent.*)	VIII Ash Content of Combined Sinks Fractions. (*Per cent.*)
Float on 1·30	6·80	6·80	6·56	3·40	6·56	100·00	35·46
1·30 to 1·40	14·10	20·90	10·96	13·85	9·53	93·20	37·57
1·40 to 1·50	21·30	42·20	17·86	31·55	13·73	79·10	42·32
1·50 to 1·55	8·10	50·30	22·75	46·25	15·19	57·80	51·33
1·55 to 1·60	5·00	55·30	27·63	52·80	16·31	49·70	55·99
1·60 to 1·65	3·70	59·00	28·98	57·15	17·10	44·70	59·16
1·65 to 1·70	2·50	61·50	32·89	60·25	17·75	41·00	61·88
1·70 to 1·80	3·30	64·80	37·89	63·15	18·77	38·50	63·76
Sink in 1·80	35·20	100·00	66·19	82·40	35·46	35·20	66·19

In the above table, column I represents the various specific gravities of the liquids employed, these being binary mixtures of toluene and carbon tetrachloride, or of carbon tetrachloride and bromoform. Column II represents the percentage by weight of dry washed coal that floats on (or in the last case, that sinks in) a liquid of given specific gravity, and is obtained by direct calculation from observed figures. Column III shows the cumulative percentage by weight of such material, the figures being computed from column II by simple addition. Column IV gives the determined ash contents of the fractions separated. Column V is obtained

from column III by taking the simple arithmetic mean in each case, as may be seen in the following example, where the Roman numerals in square brackets indicate the columns concerned.

$$\frac{59{\cdot}00\,[\text{III}] + 61{\cdot}50\,[\text{III}]}{2} = 60{\cdot}25\,[\text{V}]$$

Column VI is computed from columns II, III and IV and represents the average ash content of the combined fractions that will float on a liquid of a certain specific gravity. It is obtained by calculation from the determined ash contents of individual fractions, e.g.:

$$\frac{(6{\cdot}80[\text{II}]\times 6{\cdot}56[\text{IV}])+(14{\cdot}10[\text{II}]\times 10{\cdot}96[\text{IV}])+(21{\cdot}30[\text{II}]\times 17{\cdot}86[\text{IV}])}{42{\cdot}20[\text{III}]}=13{\cdot}73[\text{VI}]$$

Column VII is obtained from column II by simple addition, commencing with the "sinks" in 1.80. The figures thus obtained are plotted against the lower specific gravity given in column I. Finally, column VIII is calculated from columns II, IV and VII by a similar process to that used for column VI, e.g.:

$$\frac{(35{\cdot}20[\text{II}]\times 66{\cdot}19[\text{IV}])+(3{\cdot}30[\text{II}]\times 37{\cdot}89[\text{IV}])+(2.50[\text{II}]\times 32{\cdot}89[\text{IV}])}{41{\cdot}00[\text{VII}]}=61{\cdot}88[\text{VIII}]$$

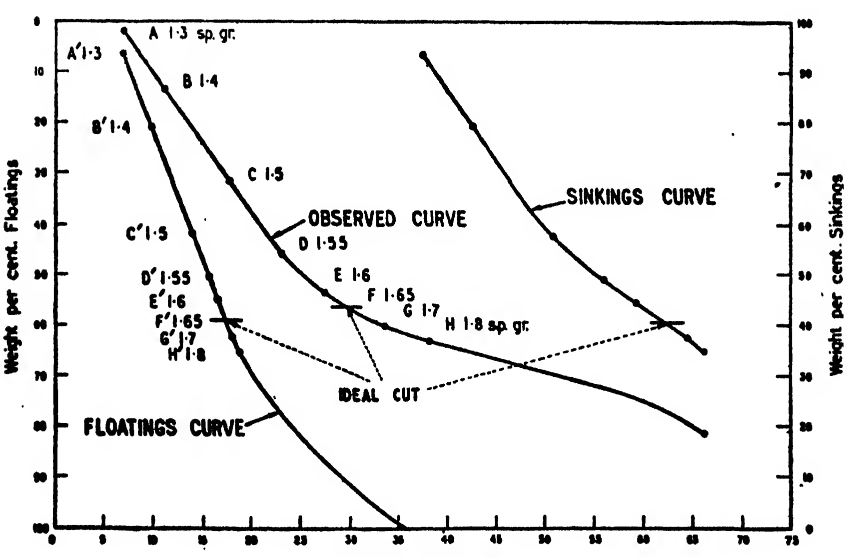


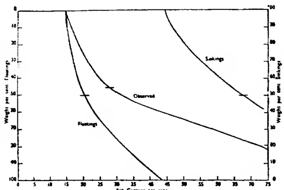
Fig. 1.—Coal Washability Curves

The three curves in Fig. 1 are constructed from the tabulated data above as follows:

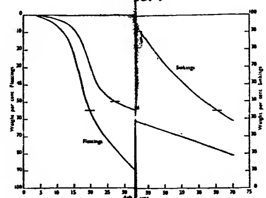
Observed Curve (also known as the Instantaneous, the Increment, and the Elementary Ash Curve). Plot figures in column IV as abscissae against column V as ordinates, i.e. the average ash of fraction against the cumulative percentage by weight to middle of

WASHABILITY CURVES OF MWELE COALS, TANGANYIKA

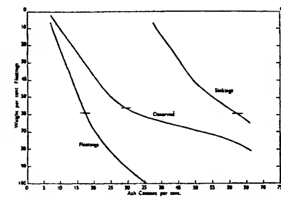
SAMPLE NO. 1



Graph 1 Size : ⅞ in. to ⅜ in.

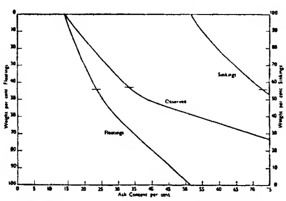


Graph 2 Size: ⅜ in. to ⅛ in.

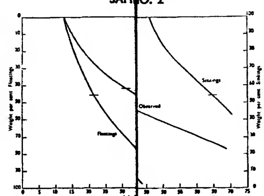


Graph 3 Size: ⅛ in. to 1 mm.

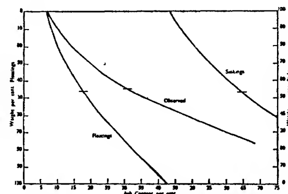
SAMPLE NO. 2



Graph 4 Size: ⅞ in. to ⅜ in.

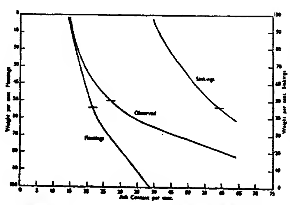


Graph 5 Size: ⅜ in. to ⅛ in.

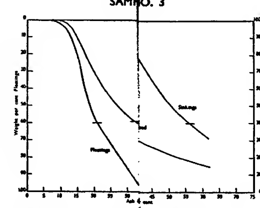


Graph 6 Size: ⅛ in. to 1 mm.

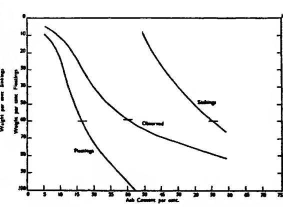
SAMPLE NO. 3



Graph 7 Size: ⅞ in. to ⅜ in.

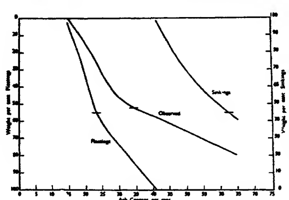


Graph 8 Size: ⅜ in. to ⅛ in.

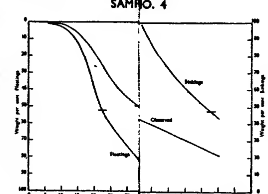


Graph 9 Size: ⅛ in. to 1 mm.

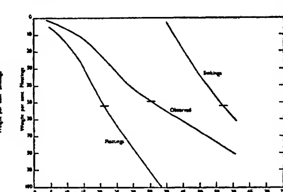
SAMPLE NO. 4



Graph 10 Size: ⅞ in. to ⅜ in.

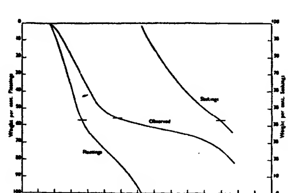


Graph 11 Size: ⅜ in. to ⅛ in.

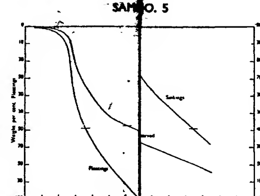


Graph 12 Size: ⅛ in. to 1 mm.

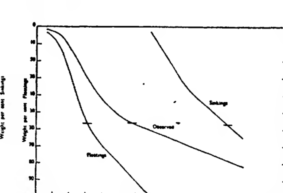
SAMPLE NO. 5



Graph 13 Size: ⅞ in. to ⅜ in.

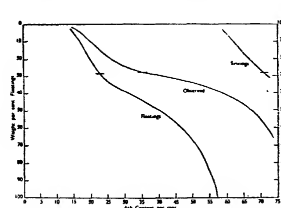


Graph 14 Size: ⅜ in. to ⅛ in.

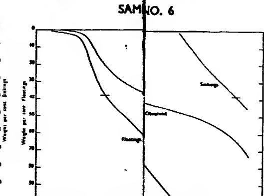


Graph 15 Size: ⅛ in. to 1 mm.

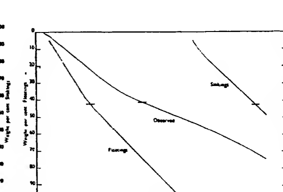
SAMPLE NO. 6



Graph 16 Size: ⅞ in. to ⅜ in.



Graph 17 Size: ⅜ in. to ⅛ in.



Graph 18 Size: ⅛ in. to 1 mm.

PL. VIII.

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it is doubtful whether the expense of installing cleaning plant is justified. This matter would require careful consideration of costs in relation to the quantities of coal required. The float and sink curves do not show a distinct elbow which would indicate an optimum yield at a given ash content in the floatings curve. General considerations, however, suggest that the yield would be of the order of 50 to 60 per cent., and that the clean coal would have an ash content of about 18 per cent. The reject material, amounting to 40 to 50 per cent. of the raw coal, would be valueless.

A high efficiency in the cleaning of coal is obtained if the proportion of middlings (coal of intermediate specific gravity) is not appreciably above 10 per cent. In the six samples examined, the proportion of middlings, regarded as material of sp. gr. 1·35 to 1·60, varies as follows:

VARIATION OF MIDDLINGS
(*Per cent.*)

	Sample No.					
	1	2	3	4	5	6
Size $\frac{5}{8}$ in. to $\frac{3}{8}$ in. . .	41	28	45	33	48	30
,, $\frac{3}{8}$ in. to $\frac{1}{8}$ in. . .	46	33	51	41	58	34
,, $\frac{1}{8}$ in. to 1 mm. .	47	42	43	43	56	27

The proportion of middlings in every case above exceeds 25 per cent. A simple washing plant of the Baum washer type could not be expected to operate with high efficiency with this proportion of middlings. An estimate of the yield and ash content of clean coal which might be obtained by washing and which has been deduced from the above results is given below.

ESTIMATED YIELD ON WASHING

	Sample No.					
	1	2	3	4	5	6
Sp. gr. of separation	*1·65*	*1·67*	*1·67*	*1·70*	*1·60*	*1·65*
Cumulative wt. of clean coal *per cent.*	55	45	55	53	57	37
Cumulative ash of clean coal ,,	19	21	20	22	17	20
Cumulative ash in sinks . ,,	65	67	57	60	58	68

It is possible that a more efficient type of washer of the Chance type employing a heavy suspension would enable a separation to be made at a lower specific gravity than that given above, resulting in a correspondingly cleaner coal, but the advantage would be small in view of the intergrown character of the inorganic matter which has been referred to above.

Fusibility of Ash

The fusion temperatures of the ash from sample No. 5 have been determined as follows:

Ash from unwashed coal	1,205° C.
Ash from washed coal	1,235° C.

In each case the initial deformation temperature was 1,120° C.

The above temperatures are on the low side, and might create difficulty with slagging in boiler practice. They are also dangerously near the border line for gas producer coals.

Distribution of Sulphur in the Coal

The average sulphur content of the samples investigated is very high, being over 4 per cent. The chief disadvantages of sulphur in the utilisation of coal are:

(*a*) Corrosion of appliances, boiler tubes, chimneys, etc.

(*b*) Pollution of the atmosphere.

It is unlikely that (*b*) would apply seriously to Tanganyika, and suitable precautions could be taken to prevent undue trouble in the case of (*a*). However, in order to assess a possible improvement in sulphur content that might be obtained by coal cleaning, the distribution of sulphur compounds was determined in the float and sink samples on the smaller size material (⅛ in. to 1 mm.). Total sulphur, sulphide or pyritic sulphur, and sulphate sulphur were determined in each case by the usual methods, organic sulphur being calculated by difference. The results obtained on sample No. 6 are shown below. Detailed data for the other five were obtained, but are not reproduced as they are of the same order.

Sulphur Contents of Fractions obtained in Float and Sink Analysis
Sample No. 6. Size: ⅛ in. to 1 mm.

Sp. Gr.	Yield of Clean Coal.	Sulphur.			
		Sulphate.	Pyritic.	Organic.	Total.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Floats on 1·30	5·4	0·02	0·30	1·79	2·11
1·30 to 1·35	5·4	0·03	0·58	1·78	2·39
1·35 to 1·40	7·0	0·04	0·60	1·72	2·36
1·40 to 1·45	7·7	0·04	0·74	1·59	2·37
1·45 to 1·50	6·4	0·04	1·00	1·43	2·47
1·50 to 1·55	4·4	0·06	1·34	1·31	2·71
1·55 to 1·60	4·3	0·07	1·89	1·11	3·07
1·60 to 1·65	2·1	0·09	2·00	1·14	3·23
1·65 to 1·70	1·3	0·10	2·14	1·05	3·29
1·70 to 1·75	2·9	0·08	2·22	1·00	3·30
1·75 to 1·80	1·8	0·08	2·45	0·86	3·39
Sinks in 1·80	51·3	0·16	6·56	0·70	7·42
Raw Coal	—	0·11	3·89	1·07	5·07

The raw coal in sample No. 6 contains about 7·3 per cent. pyrites, corresponding to 3·9 per cent. sulphur, and its organic sulphur content is 1·07 per cent. Cleaning normally removes

pyrites unless this is intergrown in small lenticles or scales but does not reduce organic sulphur content. In the case of sample No. 6, the cleanest coal separated from the ⅛ in. to 1 mm. grade contains pyrites equivalent to 0·3 per cent. sulphur, while at the ideal cut at sp. gr. 1·65 the clean coal contained 0·91 per cent. of pyritic sulphur, 1·55 per cent. of organic sulphur and 0·04 per cent. of sulphate sulphur. An efficient washer might be expected to achieve this performance, giving a clean coal of about 2·5 per cent. total sulphur content. This difficulty of separation with coal of small size is unusual and unfortunate. With larger coal, however, it is not greatly aggravated in the case of No. 6 sample; the ⅜ in. to ⅛ in. grade shows at the ideal cut an increase only to 0·97 per cent. pyritic sulphur.

The behaviour of sample No. 5 is equally satisfactory in this respect, but in the case of samples Nos. 1 to 4, the pyrites is not only higher (corresponding to 3·2 to 5·6 per cent. of sulphur) but even less easily removed, so that the clean coal still contains half of the original pyrites, and shows from 2·1 to 2·6 per cent. of pyritic sulphur and 5·1 to 5·6 per cent. of total sulphur, an unfortunately high value. In the description of the coal seam at different points, it is to be noted that the pyrites is less stratified and more lenticular in the neighbourhood of samples Nos. 5 and 6. This may explain its more effective separation. In general, however, it would seem that a real reduction in sulphur content by cleaning average coal is not to be expected. The sulphur figures for the six samples are given below; the average sulphur content of the clean coal is 4·4 per cent.

Distribution of Sulphur at Suggested Cuts
Size: ⅛ in. to 1 mm.

	Sample No.					
	1	2	3	4	5	6
Total sulphur in coal as received *per cent.*	5·3	6·8	7·0	8·1	4·2	5·1
Pyritic sulphur in coal as received *per cent.*	3·2	4·8	4·3	5·6	2·6	3·9
Suggested cut . . . sp. gr.	*1·65*	*1·67*	*1·67*	*1·70*	*1·60*	*1·65*
Yield of clean coal . . *per cent.*	59·0	46·5	60·5	51·5	57·4	42·7
Total sulphur in clean coal ,,	5·1	5·6	5·4	5·1	2·5	2·5
Pyritic sulphur in clean coal ,,	2·1	2·6	2·1	2·2	0·7	0·9
Total sulphur in dirt reject ,,	5·6	7·9	9·4	11·4	6·5	7·0
Pyritic sulphur in dirt reject ,,	4·7	6·8	7·6	9·2	5·1	6·1

General Conclusions

From the foregoing experimental investigations carried out on samples of the main coal obtained from the Namwele-Mkomolo coalfield and submitted to the Imperial Institute for economic evaluation, the following general conclusions may be drawn:

I. The Namwele coal deposits consist of non-caking bituminous

coal of high volatile matter (45 to 48 per cent. of dry, ash-free coal).

II. The seam is interbanded with dirt bands all over the deposit so that average samples representing the coal bands are very high in mineral matter (30 to 40 per cent. ash).

III. The mineral matter is so closely intermixed with the coal that coal cleaning, even of crushed coal, would not produce a really clean coal. It is indicated that raw coal "as mined" would yield 50 to 60 per cent. by weight of coal of about 18 per cent. ash content. The reject would be valueless.

IV. The sulphur content of the raw coal varies from 4·2 to 8·1 per cent.; cleaning would remove some pyrites but would not reduce the average sulphur content of the clean coal below about 4·4 per cent.

V. Careful consideration of costs and of coal requirements in Tanganyika is necessary to decide whether cleaning should be undertaken. If it is decided that some form of cleaning be undertaken, probably the best procedure would be to screen out the lump coal and clean it by hand-picking, and to reject the lumps of shale or dirt. The smaller coal should be broken to 2½ in. and washed in a Baum washer, or in a cheap form of jig washer, both dirt and washery slurry being drastically rejected.

VI. Whatever form of cleaning, however, is adopted, the seam should be treated as a whole and the waste material ruthlessly scrapped. No attempt should be made to utilise any fraction as pulverised fuel.

VII. The possibility of treating this coal by a carbonisation process to produce coke and tar is not practicable, owing to the high ash content of the coal which would be reflected in the coke and to the difficulty of operating carbonisation plant.

VIII. Although of high ash content the coal could be gasified in complete gasification processes of the type of the Lurgi high-pressure plant. The fact that this process is directed mainly to gas making precludes its introduction in a non-industrial area where the gas could not be utilised. Any possibility of treating the coal in this way to produce synthesis gas for the production of oil by the Fischer-Tropsch process is discounted at the present time. It might be worthy of consideration some years hence.

IX. Utilisation of the coal by underground gasification is not a practical proposition owing to the many shale bands and the faulted character of the seam.

Grateful acknowledgment is made to Dr. J. G. King, O.B.E., Chairman of the Imperial Institute Advisory Committee on Coal and Petroleum, for much helpful advice and criticism in the com-

pilation of this report. The experimental work on which the report is based has been carried out largely by H. J. Broughton, A.R.I.C.

APPENDIX II

Coal Analyses and Beneficiation Tests

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Metallurgists, Geological Division, Department of Lands and Mines, Tanganyika Territory

The subject matter of this report is presented under five separate sections dealing respectively with (1) comparative analyses of coal from 32 ft. and 140 ft. vertical depth in Namwele main coal; (2) results of 46 analyses of samples from crosscuts; (3) results of 24 analyses of samples taken over 600 ft. of the First Level in the Namwele sinkings; (4) sorting tests on bulk samples; and (5) beneficiation tests on a bulk sample. The conclusions and recommendations arising from this report are set out on p. 353.

Calorific values were determined by Lewis Thompson calorimeter. Later checks by bomb calorimeter serve to indicate that values up to 9,000 B.Th.U./lb. are correct ± 200 units and, over that figure, ± 100 units.

Comparative Analyses of Coal from 32 ft. and 140 ft. Vertical Depth in Namwele Main Coal

Sample No.	Where taken.
M.1181.	Coal from pit 32 ft. deep.
M.2318.	Coal from No. 2 shaft, 140 ft. depth.
M.2318A.	Cleaned coal obtained from M.2318 by sink-float separation at sp. gr. 1·50, after crushing to pass 60-mesh I.M.M. Recovery 48·1 per cent.

		Sample No.		
		M.1181.	M.2318.	M.2318A.
Proximate Analysis				
Moisture	*per cent.*	4·6	4·6	2·8
Volatile matter	"	30·0	32·6	36·5
"Fixed carbon"	"	35·5	32·6	43·2
Ash	"	29·9	30·2	17·5
Sulphur	"	8·2	7·4	3·7
Calorific value	*B.Th.U./lb.*	8,800	9,000	10,340
Coking properties		nil	v. feeble	nil

The good agreement between the first and second of the above analyses indicates that the quality of the coal does not necessarily vary greatly with increasing depth. As, however, there is great variation between samples of the same seam taken at different points on the same level, little emphasis can be laid on this point.

RESULTS OF 46 ANALYSES OF SAMPLES FROM CROSSCUTS NOS. 1, 2, 3, 4 AND 5 IN THE NAMWELE SINKINGS

TABLE II.—(*See* Pl. III)

Crosscuts Nos. 1 and 2: 399 ft. along First Level from shaft No. 1; horizontal and at right angles to the strike.

Crosscuts Nos. 3 and 4: 218 ft. along First Level from shaft No. 1; horizontal and at right angles to the strike.

Crosscut No. 5: 34 ft. 6 in. along First Level from shaft No. 1; horizontal and at right angles to the strike.

Sample No.	Field Description.	True Thickness.		Moisture.	Volatile Matter.	"Fixed Carbon."	Ash.	Calorific Value.	Sulphur.	Remarks.
		Ft.	*In.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*B.Th.U. /lb.*	*Per cent.*	
	Crosscut No. 1									
Nm. 14	Hard, compact mudstones, rather coaly	2	0	3·08	13·80	11·84	71·28	n.d.	n.d.	
" 16	Black, carbonaceous shales with some thin coal	2	2	2·48	13·68	10·16	73·68	"	"	
" 17	Coal with some shale inclusions	1	11	4·38	21·60	26·84	47·18	"	"	
" 18	Rather compact, dark, carbonaceous mudstones and shales with local thin lenses of coal	4	3	2·44	11·82	4·80	80·94	"	"	
" 19	Coal with some shale	1	0	4·62	20·92	21·26	53·20	"	"	
" 20	Dark, carbonaceous shaly mudstone	1	6	2·66	13·44	4·24	79·66	"	"	
" 21	Thin coal		2½	4·74	26·32	26·52	42·42	"	"	
" 22	Shaly coal		4	4·48	22·94	23·04	49·54	"	"	
" 23	Carbonaceous- and coal-shale	1	3	2·42	10·40	3·46	83·72	"	"	
" 24	Shaly coal		3½	4·18	24·54	22·28	49·00	"	"	
" 25	Carbonaceous shale		10	2·60	11·86	3·76	81·78	"	"	
" 26	Shaly coal		6	4·24	27·34	16·68	51·74	"	"	
" 27	Coal-shale		3	2·80	16·52	15·64	65·04	"	"	
" 28	Shaly coal		9½	5·34	33·16	33·00	28·50	8,500	5·27	Feebly coking
" 29	Carbonaceous shale	1	3	3·14	10·44	4·04	82·38	n.d.	n.d.	
" 30	Coal, in part shaly		5	4·52	29·44	28·26	37·78	7,320	5·50	
" 31	Carbonaceous shale, somewhat coaly		5½	3·02	12·46	11·20	73·32	n.d.	n.d.	
" 32	Coal		6	3·88	25·16	31·32	39·64	6,840	3·32	
" 33	Black carbonaceous shale	1	7	2·86	14·60	14·28	68·26	n.d.	n.d.	
" 34	Coal		2	3·92	26·96	23·70	45·42	"	"	
" 35	Coal		8	3·30	20·12	16·48	60·10	"	"	

		Crosscut No. 2									
„	36	Dark grey carbonaceous shale with plant remains	2	8	3·04	10·58	3·16	83·22	„	„	
„	37	Black carbonaceous shale with many thin layers of shaly coal	1	2	3·36	13·04	8·62	74·98	„	„	
„	40	Black carbonaceous shale with much shaly coal	1	2	3·92	13·30	13·16	69·62	„	„	
		Crosscut No. 3									
„	56	Coal-shale		10	2·32	14·82	10·00	72·86	„	„	
„	58	Coal, thickness widening downwards from 11 in. to	1	2	2·66	25·86	33·30	38·18	6,730	5·18	
„	59	Coal-shale		9	2·86	16·88	16·28	63·98	n.d.	n.d.	
„	60	Coal		5	3·32	26·68	25·54	44·46	„	„	
„	61	Coal		7	4·24	25·04	25·92	44·80	„	„	
„	62	Coal		1½	2·84	23·00	23·76	50·40	„	„	
„	63	Crushed shaly coal		5	3·08	20·20	14·44	62·28	„	„	
„	64	Coal		3	3·28	28·76	25·76	42·20	„	„	
„	65	Crushed shaly coal		6	2·46	17·66	15·08	64·80	„	„	
„	66	Crushed shaly coal		7½	2·92	32·20	34·22	30·66	8,310	5·73	Feebly coking
„	67	Coal with some shale	1	2	2·46	27·58	29·82	40·14	7,320	9·89	
„	68	Poor coal	1	3	2·56	31·08	35·90	30·46	8,510	10·71	
		Crosscut No. 4									
„	69	Coal-shale	1	2	3·42	25·98	30·34	40·26	5,740	4·24	
„	70	Coal	1	5	3·64	33·96	36·36	26·04	8,710	6·37	Feebly coking
„	71	Coal		11½	4·06	29·46	33·06	33·42	7,920	7·92	
„	73	Coal-shale		10	4·42	15·74	18·38	61·46	n.d.	n.d.	
		Crosscut No. 5									
„	77	Good coal	1	2	3·48	28·75	35·44	32·33	7,720	5·05	
„	78	Shaly coal.		3	3·46	15·90	24·26	56·38	n.d.	n.d.	
„	80	Coal		4½	5·04	34·24	37·96	22·76	9,100	6·32	Feebly coking
„	81	Shaly coal		3	2·74	26·10	28·06	43·10	n.d.	n.d.	
„	82	Coal		8	3·72	35·04	39·56	21·68	9,200	6·44	
„	83	Shaly coal with 1 in. shale band (omitted from sample)	1	2	3·60	28·42	33·68	34·30	7,520	2·80	

RESULTS OF 24 ANALYSES OF SAMPLES TAKEN OVER 600 FT. OF THE FIRST LEVEL (167 FT. VERTICAL) IN THE NAMWELE SINKINGS

No. of samples analysed		24*
Average sampling width	*in.*	32·4
Average Analysis:		
Moisture	*per cent.*	5·3
Volatile matter	,,	30·2
"Fixed carbon"	,,	33·3
Ash	,,	31·2
Sulphur	,,	7·2
Calorific value	*B.Th.U./lb.*	8,150

* 13 *samples were taken from one seam only*, 5 *from two seams, and* 6 *from all seams.*

From the average analysis the calorific value on the moist ash-free basis is 11,850 B.Th.U./lb. This places the coal, by the A.S.T.M. ranking, in Class II, Group 5, High volatile C bituminous coal. On the dry ash-free basis the volatile combustible matter works out at 47·6 per cent.

RESULTS OF SORTING TESTS ON RAILWAY BULK SAMPLES TAKEN FROM HEADINGS IN THE NAMWELE SINKINGS

By Engineers of Contracting Company; analyses by Geological Division

Sample No.	Where taken.
2.	From heading above and 25 ft. along sub-level, 200 ft. down No. 1 inclined shaft below First Level.
4B.	From headings above and 25 ft. and 125 ft. along sub-level, 200 ft. down No. 1 inclined shaft below First Level (734 and 1,379 cu. ft. respectively).
4C.	From heading above sub-level, 300 ft. down No. 1 inclined shaft below First Level.
4D.	From heading above sub-level, 455 ft. down No. 1 inclined shaft below First Level. The sample was taken in a faulted and shattered zone, which produced very little large-sized coal.

Run-of-mine coal was screened on a 1-in. grizzly. The oversize was sorted, the undersize screened in a ½-in. trommel. Minus 1-in. plus ½-in. material was then hand-sorted on a moving belt, the minus ½-in. material ("fines") being discarded. The sorted coal was mixed for sampling, as also was the waste, except where otherwise stated.

The volumes of headings and the weights of products obtained were as follows:

		Sample No.			
		2	4B	4C	4D
Volume of heading	*cu. ft.*	710	2,113	3,203	640
Wt. of sorted coal obtained	*kg.*	14,700	37,500	65,700	4,700
Wt. of fines, −½ in.	,,	5,700	22,040	25,520	10,175
Wt. of waste, +1 in.	,,	5,900	15,745	39,715	8,294
Wt. of waste, −1 in.+½ in.	,,	4,000	14,125	16,100	7,055
Total wt. of sample mined	*kg.*	30,300	89,410	147,035	30,224
Vol. wt. of sample	*lb./cu. ft.*	93·9	93·0	100·9	103·9
Sp. gr. of sample		1·509	1·494	1·621	1·669

Analyses of the samples are shown in Table III and the sorting tests results are tabulated below.

	Sample No.			
	2	4B	4C	4D
Proportion of picked coal obtained *per cent. by weight*	48·5	41·9	44·7	15·5
Proportion of fines, −⅛ in., screened out *per cent. by weight*	18·8	24·7	17·3	33·7
Proportion of waste, +1 in., screened out *per cent. by weight*	32·7 (waste +1 in. and −1 in.+⅛ in. together)	33·4 (waste +1 in. and −1 in.+⅛ in. together)	27·0	27·4
Proportion of waste, −1 in.+⅛ in. *per cent. by weight*			11·0	23·4
Calorific value of picked coal *B.Th.U./lb.*	9,600	9,200	9,150	9,300
Calculated total ash content of sample *per cent.*	41·97	41·59	45·86	56·49
Ash content of picked coal . „	23·26	26·90	27·54	25·78
Ash content of fines, −⅛ in. . „	42·86	41·98	39·56	44·40
Ash content of waste, +1 in. . „	69·16 (waste +1 in. and −1 in.+⅛ in. together)	59·68 (waste +1 in. and −1 in.+⅛ in. together)	72·14	73·58
Ash content of waste, −1 in.+⅛ in. „			65·92	74·28
Calculated total sulphur content of sample *per cent.*	4·78	5·26	5·85	4·40
Sulphur content of picked coal . „	6·37	6·80	9·00	6·62
Sulphur content of fines, −⅛ in. coal „	5·10	5·27	4·97	5·92
Sulphur content of waste, +1 in. „	2·22 (waste +1 in. and −1 in.+⅛ in. together)	3·31 (waste +1 in. and −1 in.+⅛ in. together)	2·36	2·58
Sulphur content of waste, −1 in.+⅛ in. *per cent.*			3·00	2·87
Proportion of total ash present in picked coal *per cent.*	26·9	27·1	26·8	7·1
Proportion of total ash present in fines, −⅛ in. *per cent.*	19·2	24·9	14·9	26·5
Proportion of total ash present in waste, +1 in. . . . . . *per cent.*	53·9 (waste +1 in. and −1 in.+⅛ in. together)	48·0 (waste +1 in. and −1 in.+⅛ in. together)	42·5	35·6
Proportion of total ash present in waste, −1 in.+⅛ in. . . . . *per cent.*			15·8	30·8

Results of Beneficiation Tests on a Bulk Sample taken from the First Level (167 ft. vertical) in the Namwele Sinkings

Details concerning Sample.

Locality.—No. 1 shaft First Level, N.W. at 167 ft., i.e. 5 ft. N.W. of peg No. 8.

Method of Taking.—The sample was taken entirely by moiling and picking and was quartered twice.

Measurement.—The cubic measurement of the sample in place was 70·9 cu. ft. Its dimensions were :

	ft.	in.
Length parallel to strike	5	9
Height	6	2
True thickness	5	4
Depth (dip of strata is 30°)	2	9

Geological Notes.—The sample was taken from the wall of the drive immediately below the grey shale marking the top of the

TABLE III.—SORTING TESTS: ANALYSES OF PRODUCTS

	Sample.		Moisture.	Volatile Matter.	"Fixed Carbon."	Ash.	Calorific Value.	Sulphur.
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*B.Th.U./lb.*	*Per cent.*
2.	E.2179/A.	Channel sample across face before sampling	5·06	26·96	30·56	37·42	7,300	5·67
	E.2179/B.	Channel sample across face after sampling	4·66	31·96	39·14	24·24	9,400	6·86
	E.2179/C.	Waste sorted out of bulk sample	2·74	15·30	12·80	69·16	n.d.	2·22
	E.2179/D.	Fines, — ½ in., screened out of bulk sample	4·94	25·30	26·90	42·86	"	5·10
	E.2179/E.	Coal as railed	4·53	33·75	38·46	23·26	9,600	6·37
4B.	E.2180/A.	Channel sample across face 125 ft. along level before starting heading	4·34	31·90	36·40	27·36	8,900	7·25
	E.2180/B.	Channel sample across face 125 ft. along level after completing heading	4·14	28·24	30·92	36·70	7,700	6·18
	E.2180/C.	Channel sample across face 25 ft. along level after completing heading	4·18	29·00	35·64	31·18	8,400	7·19
	E.2180/D.	Fines, — ½ in., screened out of bulk sample	4·58	25·36	28·08	41·98	n.d.	5·27
	E.2180/E.	Waste sorted out of bulk sample	2·86	20·16	17·30	59·68	"	3·31
	E.2180/F.	Coal as railed	4·96	31·56	36·58	26·90	9,200	6·80
4C.	E.2181/A.	Channel sample across face before starting heading	5·04	26·84	31·82	36·30	7,900	6·89
	E.2181/B.	Channel sample across face after completing heading	3·40	25·02	28·06	43·52	6,900	5·45
	E.2181/C.	Fines, — ½ in., screened out of bulk sample	4·24	26·02	30·18	39·56	n.d.	4·97
	E.2181/D.	Waste sorted out of bulk sample, + 1 in.	2·60	13·76	11·50	72·14	"	2·36
	E.2181/E.	Waste sorted out of bulk sample, — 1 in.	2·20	17·46	14·42	65·92	"	3·00
	E.2181/F.	Coal as railed	3·74	29·64	39·08	27·54	9,150	9·00
4D.	E.2182/A.	Channel sample across face before starting heading	4·70	30·52	34·28	30·50	8,300	6·79
	E.2182/B.	Fines, — ½ in., screened out of bulk sample	3·60	26·00	26·00	44·40	n.d.	5·92
	E.2182/C.	Waste sorted out of bulk sample, + 1 in.	2·62	15·60	8·20	73·58	"	2·58
	E.2182/D.	Waste sorted out of bulk sample, — 1 in.	2·62	14·84	8·26	74·28	"	2·87
	E.2182/E.	Coal as railed	3·70	33·20	37·32	25·78	9,300	6·62

" Coal Zone " and the true thickness of the strata sampled was 64 in., the dip being 30°. The Coal Zone where sampled carried less than the average coal content. Measured sections were as follows, true thicknesses being expressed in inches.

N.W. End of Sampling Width		*Centre of Wall after Removal of Sample*		*S.E. End of Sampling Width*	
COAL . . .	4¼	COAL and shale .	1	COAL . . .	5
Shale with fine coaly layers . .	2	COAL . . .	3	Shale . . .	2
COAL . . .	3	Shale, a bit coaly .	1	COAL . . .	5¼
Dark shale with little coal . . .	1¼	COAL . . .	1¾	Dark grey shale .	¾
COAL . . .	2	Dark shale . .	7¾	COAL, with some shaly coal .	15
Dark grey shale .	1½	COAL . . .	11	Coal-shale . .	2
COAL . . .	21	COAL, a bit shaly.	6½	COAL, a bit shaly.	3
Black shale . .	7¾	Black shales .	8	Black shale . .	8½
COAL . . .	3½	COAL . . .	4	COAL, a bit shaly.	4
Black shale . .	2¼	Black shales .	4	Black shale . .	2
COAL and some shale	8¾	COAL . . .	5	COAL . . .	2¼
Shale and some coal	5¼	Black shale with some coal . .	5	Coal-shale . .	13
		COAL . . .	3¾		
Total coal approx.	34	Total coal approx.	29	Total coal approx.	30

Preparation of Sample.—The weight of sample received for laboratory tests was 1,405 lb., or one-quarter of the whole. It was mixed without crushing and divided by quartering into two portions, A and B, weighing respectively 716 and 689 lb. Portion B was again thus divided into two portions, B.1 and B.2, weighing respectively 340 and 349 lb. Portion B.2 was repeatedly crushed and quartered to provide a general sample for analysis. Portions A and B.1 and also B.2 were used for the tests described below.

Analysis of Sample.—The following results were obtained on analysis of sample B.2 :

Proximate Analysis		
Moisture	*per cent.*	3·27
Volatile matter	,,	22·35
" Fixed carbon "	,,	32·98
Ash	,,	41·40
Calorific value	*B.Th.U./lb.*	5,800
Sulphur	*per cent.*	2·55
Coking qualities		nil

Test I. Hand-Sorting

Portion A was used for this test. The large lumps, ranging in size from 9 in. to 4 in., were first picked out and reserved as " coal." The residue was screened on 1-in., and the plus 1-in. hand-sorted into " coal " and " waste." The minus 1-in. material was not hand-sorted, but was treated as " waste." The " coal " portions were combined and analysed together. The plus 1-in. and minus 1-in. " wastes " were analysed separately.

The results of this test are tabulated below. The coal had no coking properties.

	Coal.	Plus 1-in. Waste.	Minus 1-in. Waste.	Percentage Distribution.		"Head" Analysis.	
				In Coal.	In Waste.	Actual.	Calculated.
Proportion . *per cent.*	36·9*	19·4	43·7	—	—	—	—
Proximate Analysis							
Moisture . *per cent.*	3·36	3·00	3·72	36·0	64·0	3·27	3·45
Volatile matter ,,	27·48	16·82	23·18	43·1	56·9	22·35	23·54
" Fixed carbon " ,,	38·16	26·14	32·64	42·1	57·9	32·98	33·34
Ash . . . ,,	31·00	54·04	40·46	28·9	71·1	41·40	39·67
Sulphur . ,,	2·52	1·67	3·44	33·7	66·3	2·55	2·76
Calorific value *B.Th.U./lb.*	7,400	4,750	6,140	43·1	56·9	5,800	6,300

* *Comprising* 22·4 *per cent. lumps and* 14·5 *per cent.* + 1 *in.*

Test II. Heavy-Medium Separation (Sink-Float)

Portion B.1 was screened on 1-in. and the oversize crushed to pass 2-in. ring and again screened on 1-in. The combined undersize was screened on ½-in., ¼-in., and 10-mesh I.M.M. An aliquot portion of the minus 10-mesh material was screened on 30-mesh I.M.M. Samples of each mesh-fraction were submitted to sink-float tests, the heavy medium being carbon tetrachloride-benzene mixture of sp. gr. 1·50. The material which floated in this medium was designated " coal," and that which sank " waste."

The results of this test are shown in Table IV. The coal had feeble coking properties.

Test III.—Heavy-Medium Separation, followed by Treatment of Waste by Flotation

The " waste " from Test II was wet-ground in a ball-mill in closed circuit at 60 per cent. solids to the following screen analysis :

+100 mesh I.M.M. . . .	*per cent.*	0·7
−100+200 ,, ,, ...	,,	13·3
−200 ,, ,, ...	,,	86·0

The ground material was conditioned with soda ash (2·0 lb. per short ton) and sodium cyanide (0·5 lb. per short ton) and floated in a laboratory sub-A flotation cell with eucalyptus oil (0·5 lb. per ton) and coal tar creosote (2·0 lb. per ton). The last was added in stages, 0·5 lb. per ton at a time, and the indications were that a lesser amount of reagent would have sufficed if added in smaller portions at frequent intervals. A rougher concentrate was removed and not re-cleaned. This was regarded as " coal " and the tailings as " final waste."

TABLE IV.—RESULTS OF HEAVY-MEDIUM SEPARATION (TEST II)

		Screen-size.						Total.	Percentage Distribution.
		−2 in.+1 in.	−1 in.+½ in.	−½ in.+¼ in.	−¼ in.+10 mesh.	−10 + 30 mesh.	−30 mesh.		
Proportion	*per cent.*	45·9	11·2	10·6	13·2.	8·5	10·6	100	—
Coal (Float):									
Proportion of product	*per cent.*	18·1	22·2	24·7	30·1	30·1	25·0	—	—
Proportion of total	"	8·3	2·5	2·6	4·0	2·5	2·7	22·6	—
Proximate Analysis									
Moisture	"	4·52	4·18	4·38	4·74	3·80	5·40	4·53	29·4
Volatile matter	"	33·62	34·60	35·40	35·96	36·46	35·18	34·85	35·5
"Fixed carbon"	"	43·44	45·22	45·98	48·04	49·06	49·98	46·47	33·1
Ash	"	18·42	16·00	14·24	11·26	10·68	9·44	14·15	7·5
Sulphur	"	4·18	3·49	3·58	3·58	3·87	3·89	3·86	32·9
Calorific value	*B.Th.U./lb.*	9,700	9,900	10,200	10,500	10,700	10,300	10,100	39·1
Waste (Sink):									
Proportion of product	*per cent.*	81·9	77·8	75·3	69·9	69·9	75·0	—	—
Proportion of total	"	37·6	8·7	8·0	9·2	6·0	7·9	77·4	—
Proximate Analysis									
Moisture	"	3·12	3·00	3·34	3·36	2·54	3·64	3·17	70·6
Volatile matter	"	17·78	19·40	18·22	18·38	19·22	20·82	18·49	64·5
"Fixed carbon"	"	26·90	28·80	27·66	27·52	26·90	28·70	27·46	66·9
Ash	"	52·20	48·80	50·78	50·74	51·34	46·84	50·88	92·5
Sulphur	"	1·57	2·11	2·35	2·70	4·25	4·04	2·30	67·1
Calorific value	*B.Th.U./lb.*	4,550	4,750	4,650	4,450	4,550	4,850	4,600	60·9

"Head" Analysis.	Proximate Analysis.				Sulphur.	Calorific Value.
	Moisture.	Volatile Matter.	"Fixed Carbon."	Ash.		
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*B.Th.U./lb.*
Calculated	3·48	22·18	31·74	42·60	2·65	5,800
Actual	3·27	22·35	32·98	41·40	2·55	5,800

TEST III.—RESULTS OF FLOTATION OF WASTE FROM HEAVY-MEDIUM PROCESS

	Coal.	Final Waste.	Percentage Distribution. In Coal.	Percentage Distribution. In Final Waste.	"Head" Analysis. Actual.	"Head" Analysis. Calculated.
Proportion . *per cent.*	51·5	48·3	—	—	—	—
Proximate Analysis						
Moisture . *per cent.*	2·34	1·62	60·5	39·5	3·17	1·99
Volatile matter ,,	23·14	14·26	63·3	36·7	18·49	18·81
" Fixed carbon " ,,	40·78	11·70	78·7	21·3	27·46	26·74
Ash . . ,,	33·74	72·42	33·1	66·9	50·88	52·46
Sulphur . . ,,	1·96	2·10	49·7	50·3	2·30	2·03
Calorific value *B.Th.U./lb.*	6,900	n.d.	77·2	22·8	4,600	—

RESULTS OF TOTAL EXTRACTION FROM COMBINED PROCESSES

	Lumps and Fines (Heavy-Medium Concentrate).	Pulverised Coal (Flotation Concentrate).	Final Waste.	Percentage Distribution. In Lumps and Fines.	Percentage Distribution. In Pulverised Coal.	Percentage Distribution. In Final Waste.
Proportion . *per cent.*	22·6	39·8	37·6	—	—	—
Proximate Analysis						
Moisture . *per cent.*	4·53	2·34	1·62	39·9	36·3	23·8
Volatile matter ,,	34·85	23·14	14·26	35·1	41·0	23·9
" Fixed carbon " ,,	46·47	40·78	11·70	33·7	52·1	14·2
Ash . . ,,	14·15	33·74	72·42	7·3	30·6	62·1
Sulphur . . ,,	3·86	1·96	2·10	35·7	31·9	32·4
Calorific value *B.Th.U./lb.*	10,100	6,900	n.d.	39·4	47·3	13·3

" Head " Analysis.	Proximate Analysis. Moisture.	Proximate Analysis. Volatile Matter.	Proximate Analysis. " Fixed Carbon."	Proximate Analysis. Ash.	Sulphur.	Calorific Value.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*B.Th.U./lb.*
Calculated . .	2·57	22·44	31·15	43·84	2·44	—
Actual . .	3·27	22·35	32·98	41·40	2·55	5,800

Test IV.—Bulk Flotation

A sample was cut out from Portion B.2 and wet-ground in a ball-mill in closed circuit at 60 per cent. solids to the following screen analysis:

+100 mesh I.M.M.	*per cent.*	0·2
−100+200 ,, ,, ...	,,	14·6
−200 ,, ,, ...	,,	85·2

The ground material was conditioned and floated as in Test III but using rather less coal tar creosote. A rougher concentrate was removed and re-cleaned in the same cell with the addition of coal

tar creosote, 0·8 lb. per ton. The final products were a cleaner concentrate, a cleaner tailing or middling, and a rougher or final tailing. These were regarded respectively as "coal," "middling" and "waste."

TEST IV.—RESULTS OF BULK FLOTATION TESTS

	Coal.	Midd-ling.	Waste.	Percentage Distribution.			"Head" Analysis.	
				In Coal.	In Midd-ling.	In Waste.	Actual.	Calcu-lated.
Proportion . *per cent.*	61·4	15·7	22·9	—	—	—	—	—
Proximate Analysis								
Moisture . *per cent.*	3·56	2·08	1·00	79·7	11·9	8·4	3·27	2·74
Volatile matter ,,	26·68	20·24	12·86	72·8	14·1	13·1	22·35	22·51
"Fixed carbon" ,,	43·60	21·08	8·00	83·9	10·4	5·7	32·98	31·92
Ash . ,,	26·16	56·60	78·14	37·5	20·7	41·8	41·40	42·83
Sulphur . ,,	2·48	2·71	3·85	53·8	15·0	31·2	2·55	2·83
Calorific value *B.Th.U./lb.*	8,400	n.d.	n.d.	89·0	11·0		5,800	—

Test V.—Specific Gravity

Specific Gravity of Shale

A number of lumps of shale hand-picked from the minus 2-in. plus 1-in. waste from Test II were tested with a Walker Steelyard. Two sets of four measurements gave respectively mean values of 1·87 (extremes 1·61 and 2·19) and 1·88 (extremes 1·78 and 1·98).

Specific Gravity of Coal

The exact determination of the specific gravity of the coal substance is so difficult as to be regarded as a practical impossibility. The coal is so finely interlaminated with shale that separation of a representative sample could not be achieved. It was possible to extract fragments of coal substance but not to obtain a representative mixture of the various components thereof (fusain, durain, vitrain, etc.).

In order to obtain some sort of comparable figures, that portion of the sample which floated in a medium of sp. gr. 1·50 was considered arbitrarily as "coal," and that which sank as "shale." A portion of the sample which passed 10-mesh and was retained on 30-mesh I.M.M. was used for the test.

The determinations were made at first with a pycnometer, using, as water does not wet coat adequately, either benzene or amyl acetate. The latter was found the more satisfactory. The result for shale was checked by a rough fractionation into groups of varying specific gravity, using mixtures of bromoform and benzene as heavy media.

Later a method was devised for more accurate determination of

specific gravity by embedding the sample, either powdered or previously briquetted, in a plastic mount at high pressure.

Method 1.—Using a pycnometer and amyl acetate the following results were obtained:

General sample	. . . . .	1·73 and 1·74
Coal . .	Mean 1·31 ;	extremes 1·27 and 1·37
Shale . .	Mean 2·01 ;	extremes 1·99 and 2·04

Method 2.—By fractionating the shale into specific gravity groups the following result was obtained:

Sp. gr. 1·50 to 2·00	*per cent.*	57
„ 2·00 to 2·40	„	25
„ greater than 2·40		18

The average works out at about 2·0, in good agreement with the result in Method 1.

Method 3.—By embedding the sample in a plastic mount, the following results were obtained:

General sample (briquetted) . .	*sp. gr.*	1·75
„ „ (powdered) . .	„	1·77
Flotation concentrate, Test IV (briquetted)	„	1·52
„ „ „ IV (powdered)	„	1·53
„ „ „ III (briquetted)	„	1·64

PARTIAL SUMMARY OF BENEFICIATION RESULTS

	Hand-Sorting.	Heavy-Medium (Sink-Float).	Flotation of Waste from Heavy-Medium Process.	Flotation of Coal as a Whole.*
Recovery of coal *per cent.*	36·9	22·6	51·5 (on waste) 39·8 (on total)	61·4
Nature of cleaned coal obtained.	Non-coking lumps, 9 in. to 1 in.	Feebly coking lumps and fines, minus 2-in.	Non-coking pulverised minus 100-mesh I.M.M.	Non-coking pulverised minus 100-mesh I.M.M.
Calorific value, B.Th.U./lb., raised from 5,800 to. .	7,400	10,100	6,900	8,400
Ash, per cent., reduced from 41·40 to .	31·00	14·15	33·74	26·16
Sulphur, per cent., altered from 2·55 to . .	2·52	3·86	1·96	2·48
Recovery of thermal content *per cent.*	43·1	39·1	72·2 (on waste) 47·3 (on total)	89·0

* *The recovery of coal by flotation would be slightly higher than as shown, owing to the fact that middlings would be re-circulated in continuous operation and not separated as in these batch tests.*

General Conclusions

The following general conclusions and observations may be drawn, in the light of the foregoing tests and analyses.

I. Only low recoveries of usable coal can be obtained by any of the treatment methods described above. As, however, the sample contained less than the average coal content normally noted in these workings, it can be expected that somewhat higher extractions could be obtained from the better qualities although it is unlikely that the calorific value of the products would be significantly improved.

II. Hand-sorting gives a yield of slightly improved coal, but a recovery of only 36·9 per cent. Heavy-medium (sink-float) processes greatly improve the quality of the coal but extract only 22·6 per cent., and necessitate crushing to pass at least 2-in. ring, thereby producing much fines. Flotation methods, applied either to the waste from the other processes or to the coal as a whole, give recoveries of 50 to 60 per cent. but the quality of the coal is not greatly improved, and the product is in a pulverised condition.

III. The results of the tests on this sample would not appear to be encouraging with regard to commercial exploitation of this coal, but it may be pointed out here that other samples from these workings have shown much better analyses and that bulk samples of hand-picked coal have been used with some measure of success by the local railways. In fact, the presence of local railways and of a developing metal mine distant about 180 miles from the coal deposits renders the economic exploitation of this coal far more likely than would at first sight appear possible.

IV. Hand-sorting of the coal, in spite of the low recovery obtained, can yield a product suitable for local use in locomotives. Heavy-medium separation processes applied either to the coal in bulk or to the waste from hand-sorting can yield a much better product while flotation either of wastes from the above processes or of the coal in bulk can give a yield of improved but pulverised coal.

V. Hand-sorted coal and the concentrate from heavy-medium separation processes can be supplied to the railways or burnt on the spot to generate electric power. Flotation concentrates can be burnt on the spot in pulverised-coal burners to generate electric power. The fine coal might be briquetted.

VI. The coal, being non-coking, cannot be used for the preparation of coke for blast furnaces.

APPENDIX III

Railway Steaming Tests

Résumé of a Report by the Chief Mechanical Engineer, Tanganyika Railways and Ports Services, dated 29th November, 1945

Bulk samples Nos. 1, 2* and 3, from which waste had been removed by hand-sorting, were tested under operating conditions by the Tanganyika Railways and Ports Services. They were burned in the same locomotive pulling almost identical loads on an uphill haul of 267 km. Driving conditions were kept as closely as possible identical in the three tests. As a control, a similar run was made with South African coal as at present used.

The consumption of Namwele coal was about 74 lb. per km., and that of South African coal about 49 lb. per km.

With Namwele coal, point-to-point running times could easily be maintained, but occasional halts totalling about one hour were necessary to clear the fire of the clinker which formed owing to the high iron content of the ash. It was agreed that clinker formation could be reduced by modifying the design of the grate.

The chief objections to the use of this coal were: (*a*) the locomotive tenders could not carry sufficient coal to last between normal coaling stations (during the tests an extra truck was used); and (*b*) the time lost in cleaning out clinker. Both these objections could be overcome if and when coal from Namwele can be produced at prices competitive with those of imported coal.

* Same sample as in Sorting Tests above.

APPENDIX IV

Hydraulic Limestone at Namwele

By F. Oates, O.B.E., B.Sc., A.R.S.M., M.Inst.M.M.

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In the Calcareous Series of the Karroo formation at Namwele, there occur nodules and thin intermittent beds of limestone (samples M.1182 and M.1226), a rough estimate giving the proportion of limestone as 10 per cent. The quantity available runs into several thousands of tons. The limestone has proved on test to be hydraulic, and to have the following chemical composition, the insoluble material being of a clayey nature: SiO_2, 7·82, per cent.; other insolubles, 2·44; R_2O_3, 1·34; CaO, 39·12; MgO, 7·66; loss on ignition, 39·86; total 98·24.

The associated marls could possibly be used for the manufacture of Portland cement, but their variable composition and the variable proportion of limestone beds would introduce difficulties in control.

ABSTRACTS AND NOTES

Tantalum Ores of Western Australia.—A large proportion of the world's supply of high grade tantalite has been obtained from Western Australia, which is unique for the number of localities in which tantalum and columbium minerals are found. From 1905 to 1943, the total production of tantalite, obtained largely from the Pilbara District, amounted to 250·97 long tons, valued at £A103,498·50, of which 195·24 tons came from alluvial deposits and 55·73 tons from lode occurrences. The study of the mineralogy and chemistry of the tantalum minerals in this State was initiated many years ago by the late Dr. E. S. Simpson, and was carried on by the Mineral Section of the Government Chemical Laboratory. Much of this work has hitherto remained unpublished, but has now been made use of in the compilation of a comprehensive reference book entitled "Tantalum and Niobium," by K. R. Miles, D. Carroll and H. P. Rowledge (*Bull. No.* 3, *Mineral Resources of Western Australia, Department of Mines*, 1945, 150 pp.). The work is divided into three parts, the first of which gives a general outline of the geology of the productive areas of Western Australia, and enumerates the minerals that are mined. Hints are supplied to assist prospectors in their search for tantalum minerals, and information is furnished concerning the marketing of these minerals. The second part deals with the properties and uses of tantalum and columbium and lists all the known minerals containing these metals. An account is also given concerning the methods of extracting the metals from their ores. The third part includes details of the crystallography and the physical, chemical and optical properties of the various tantalum-columbium minerals of Western Australia. A mineral locality map is appended.

E. H. B.

Australian Sillimanite, Kyanite, etc.—In this BULLETIN (1938, 36, 493-8) there appeared an account of some Empire sources of the andalusite, kyanite, sillimanite, etc. family of minerals. All of these invert on calcination to mullite, which in modern practice is so widely employed in refractories in the metallurgical glass and ceramic industries. That account dealt with deposits of these minerals in India, the principal Empire and world source before the war, and with some known but then unworked deposits in East Africa (on which a certain amount of testing had just been carried out at that time at the Imperial Institute) and in Australia.

Within recent years, and particularly during the war, the Australian deposits have achieved enhanced importance, so that, in view of the considerable world demand for these minerals at the present time, a summary of a comprehensive account of this family of minerals which has just appeared (*Sillimanite, Kyanite, etc.*

Mineral Resources of Australia, Summary Report No. 26, 1946; Canberra, Department of Supply and Shipping) may be of interest.

According to the official summary, sillimanite is the only refractory mineral at present produced in Australia, although kyanite may be produced in Western Australia in the near future. The production of sillimanite has risen considerably during the World War II and will probably continue to increase in the immediate future. The consumption of refractory minerals in Australia is not likely to increase appreciably, but the export trade in sillimanite is steadily growing. During 1945, Australian sillimanite satisfied approximately 60 per cent. of the Australian demand for refractory minerals. However, none of the Australian deposits has yet produced material of a sufficiently high grade for use in certain branches of the refractory industry, and, because of this, Australia will need to continue the import of Indian kyanite to the extent of approximately 40 per cent. of the total consumption of refractory minerals.

E. R. V.

Production of Minerals and Metals in Cyprus.—The table on p. 357, furnished by the Inspector of Mines at Nicosia, shows the quantities of minerals and metals produced (or exported) in Cyprus during the years 1939 to 1945. Before the war, practically all the copper concentrates produced were exported to Germany, whereas the cupreous pyrites went to France, Germany and the Netherlands. As a result, however, of the loss of these markets due to the outbreak of war and to the difficulties experienced in finding fresh markets, as well as to the prevailing high freight rates, exports, and hence production, came almost to a standstill. The position, nevertheless, improved as the war proceeded.

W. B.

Mineral Production and Exports of Nigeria.—The Chief Inspector of Mines reports the following production and exports of minerals during the first six months of 1946.

	Production.	Exports.	Average African Labour.
Tin ore (estimated 72·5% Sn)	7,419 *long tons*	7,602 *long tons*	57,119 (*a*) 47,490 (*b*)
Columbite (estimated 65% Cb_2O_5)	845 „	551 „	3,397 (*a*) 3,008 (*b*)
Tantalite (estimated 55% Ta_2O_5)	0·24 „	6·77 „	17 12
Wolfram (estimated 65% WO_3)	1·62 „	1·17 „	32 23
Gold bullion (880 fineness)	1,696 *troy oz.*	1,380 *troy oz.*	3,178 (*a*) 2,890 (*b*)

(*a*) *First quarter*, 1946.
(*b*) *Second quarter*, 1946

W. B.

CYPRUS—PRODUCTION OF MINERALS AND METALS, 1939-45

		1939.	1940.	1941.	1942.	1943.	1944.	1945.
Cupreous and Iron Pyrites (0·7–2% Cu)	*long tons*	839,346	249,330	9,344	7,878	9,095	12,986	35,225
Copper concentrates (18–20% Cu) .	„	109,434	38,808	—	—	—	—	—
Chrome ore (48% Cr_2O_3) . . .	„	7,873	4,691	—	15,786	480	—	3,240
Asbestos fibre	„	8,780	7,841	5,829	1,542	1,331	2,528	3,132
Gold	*fine oz.*	*16,954*	*14,456*	*21,401*	*10,002*	*5,480*	*958*	—
Silver	„	*104,222*	*65,070*	*101,461*	*38,581*	*17,282*	*4,882*	—
Gypsum, crude (exports) . . .	*long tons*	2,531	404	15	—	—	2,887	1,780
Gypsum, calcined (exports) . .	„	2,441	997	135	224	110	458	655
Terra Umbra (exports)	„	8,541	3,741	325	130	56	1,165	3,436
Magnesite (exports)	„	—	—	—	—	2	141	283

Geology of the Kingston District of Jamaica.—An outline of the geology of the Kingston district, accompanied by a coloured geological map on the scale of 1 inch to 1 mile, has recently been prepared by Dr. C. A. Matley and published by the Crown Agents for the Colonies on behalf of the Institute of Jamaica (1946, price 2*s*. 6*d*., 4 pp.). The account is intended to serve temporarily as an explanation of the main features of that map, pending the issue of a Memoir now in preparation, of the geology of the area.

The district consists largely of mountainous country rising to over 5,000 ft. The mountains are of two types—limestone and non-limestone, the limestone region being a forested or " bush " karstland, and the non-limestone a highly dissected area of steep slopes and gorges separated by knife-edged ridges and undergoing very rapid erosion. The mountain front comes in places close to the sea, but north of Kingston is a large embayment, the Liguanca Plain of sand, gravel and clay, which rises steadily to meet the foot of the hills at a varying height, which at Papine exceeds 700 ft. The principal geological formations are briefly described, ranging from the Basal Complex (probably pre-Mesozoic) through the Upper Cretaceous, Eocene, Miocene, Pleistocene (?), and Recent. The igneous rocks consist of granodiorite, the Newcastle porphyry sill, and basic intrusives.

E. H. B.

BOOK REVIEWS

Books for review should be addressed to " The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

ADSORPTION. By C. L. Mantell, Ph.D. Pp. viii + 386, 8½ × 5½. (New York and London : McGraw-Hill Book Company, Inc., 1945.) Price 27*s*.

The operation that deals primarily with the utilisation of surface forces and the concentration of materials on the surfaces of solid bodies is commonly known as " adsorption." Though the nature of these forces is still incompletely understood, they are of great practical importance, for they enable various solid substances, known as " adsorbents," to be used in large tonnages in the recovery of solvents, in the purification of oils, in the fractionation of mixed gases, and in many other industrial processes. Some adsorbents, such as fuller's earth, have been known from remote antiquity : others, such as synthetic and carbonaceous " zeolites " are of quite modern innovation.

From a commercial point of view the principal industrial adsorbents may be classified as follows, in order of their tonnage consumed :

Adsorbent.	Important Industrial Uses.
Fuller's earth . . .	Refining of petroleum fractions, vegetable and animal oils and fats, and waxes.
Bauxite	Percolation treatment of petroleum fractions ; dehydration of gases.
Acid-treated clays . .	Contact filtration of petroleum fractions.
Bone char or bone black .	Sugar refining ; ash removal from solutions.
Decolorising carbons and water carbons . .	Sugar refining ; refining of vegetable and animal oils and fats and of waxes ; miscellaneous decolorising of inorganic and organic substances ; water purification ; purification of dry-cleaning fluids ; purification of food products.
Gas-adsorbent carbon .	Solvent recovery ; recovery of gasoline from natural gas ; elimination of industrial odours ; purification of carbon dioxide and industrial gases ; gas masks.
Alumina. . . .	Dehydration of air, gases, and liquids.
Silica gel . . .	Dehydration and purification of air and industrial gases ; air conditioning ; refining of petroleum distillates ; gas masks.
Base-exchange silicates .	Water treatment.
Magnesia . . .	Treatment of gasoline and regeneration of dry-cleaning solvents.
Medicinal carbons . .	Elimination of bacteria and toxic poisons ; an addition to animal foods.
Metal-adsorbent chars .	Recovery of precious metals.

All the above-mentioned adsorbents are considered in some detail in Dr. Mantell's new work, which sets out to describe not only the adsorbents themselves, but also their manufacture, properties and applications. The work is divided into 18 chapters, largely devoted to specific adsorbents, but including chapters on the theories of adsorption, on odour removal, gas masks, " gas hydrates," chromatographic adsorption analysis, and on the inspection, specifications, and testing of adsorbents. It concludes with a 24-page Appendix enumerating various fundamental laws, energy relations, and conversion factors which are of the utmost importance in this particular branch of chemical engineering science.

The work is amply illustrated and well produced, despite the caution that " it is produced in full compliance with the government's regulations for conserving paper and other essential materials." It will certainly, as the author hopes, meet the need at the present time for correlated information in the very rapidly growing field of industrial adsorption.

E. H. B.

ASPHALTS AND ALLIED SUBSTANCES. Their Occurrence, Modes of Production, Uses in the Arts and Methods of Testing. By Herbert Abraham. 5th edition. Vol. 1, pp. xviii + 887 ; Vol. 2, pp. viii + 889-2,142 ; 9½ × 6¼. (New York : D. Van Nostrand Company, Inc. ; London : Chapman & Hall, Ltd., 1945.) Price 100s., the two volumes.

When the fourth edition of this book was reviewed in this BULLETIN (1939, 37, 143, 144), it was suggested that Part 6, dealing with methods of testing, might usefully be issued as a

separate volume in the next edition. This arrangement is adopted in the new edition: Volume 1 bears the title *Raw Materials and Manufactured Products*, and is comprised of Parts 1 to 5; Volume 2 contains Part 6, the bibliography, references and indexes.

There has been practically no alteration in the headings of the six parts and the 37 chapters, the 650-page increase in size of the work being due, in the main, to a considerable enlargement of Parts 5 and 6 and the references, and to the insertion of three indexes, covering respectively, specifications, names of authors and patentees, and patents.

Relatively few alterations and additions have been made in the first four parts, which deal with the history, classification, properties, occurrence, production and processing of asphalts and similar materials. It is, however, rather surprising to find that the well-known term "rafaelite" is not mentioned in the index, although it does occur in the text on page 266. In Part 5, which considers manufactured products and their uses, the chapter on bituminous paving materials contains much additional information regarding definitions, applicability, preparation and uses of these products. The succeeding chapter, on bituminised fabrics, felts and papers for roofing, flooring, waterproofing, building and insulating purposes, has also been noticeably revised and enlarged.

In Volume 2, three sections of Part 6, which now covers 620 pages, have been greatly enlarged: these are Chapter 22, which deals with examination of crude, refined and blended bituminous substances; Chapter 23, on examination of bituminous substances combined with discrete aggregates; and Chapter 24, dealing with examination of bituminised fabrics. The bibliography now embraces more than 1,300 works, and the number of references has risen to over 20,000, including about 12,000 patents of 24 countries. The additional indexes provide a useful cross-reference system for industrialists, lawyers and others who have to handle the vast accumulation of patent literature connected with asphaltic materials.

In view of the part that asphaltic products will play in post-war reconstruction, the author is to be congratulated on this timely and painstaking revision of his comprehensive work.

P. L. R.

INDUSTRIAL RESEARCH AND DEVELOPMENT IN THE UNITED KINGDOM: A SURVEY. By Sir H. Frank Heath, G.B.E., K.C.B., and A. L. Hetherington, C.B.E. Pp. xiii + 375, $5\frac{1}{4} \times 8\frac{1}{2}$. (London: Faber and Faber, Ltd., 1946.) Price 25*s*.

To survey the long history and great achievements of industrial research and development in Britain, and to produce for the layman a readable book on the subject is no mean task, and one which few are so well qualified to undertake as the authors of this book. Both have had long administrative experience in the Department of Scientific and Industrial Research, which has given them a wide

knowledge of British research; and in the preparation of this survey they have further been assisted by leading experts in each of the many branches of industrial science.

In the first half of the book short chapters are devoted to each of 24 of the principal productive industries, arranged alphabetically from Automobiles to Textiles, and then follows a section on the servicing industries—building, communications, food and laundries. The second half deals with the research activities sponsored by the Government and by independent institutions such as the Universities, the Royal Society and other scientific and professional societies. Under the heading "Government Action," the development and work of the D.S.I.R., the Research Associations and Stations, the Research Councils, and research for the Defence Services, are concisely reviewed. Finally, there is a brief survey of some of the general factors affecting industrial progress. In 1944, when this book was written, many of Britain's latest achievements in scientific research were still war secrets, and so there is no mention of them here, but in view of the wide publicity these have since received elsewhere, this detracts little from the value of the book.

It is perhaps unfortunate that the authors have adopted an alphabetical arrangement of their subject matter, as this separates such kindred topics as the Automobile and the Internal Combustion Engine, Coal and Gas, Pottery and Refractories, etc., and tends to obscure the fundamental interdependence between our industries and the natural resources of our Empire.

T. D.

BIBLIOGRAPHY

Compiled by MISS J. M. CULLINAN, B.A.

Comprising the more important reports, articles, etc., contained in publications received in the Library of the Imperial Institute during the three months, August-October 1946.

The publications issued by the Governments of the Colonies and Protectorates can be obtained from or through the Crown Agents for the Colonies, 4 *Millbank, Westminster, S.W.*1. *Applications for Dominion and Indian Government publications may be made to the Offices of the High Commissioners or Agents-General in London.*

OFFICIAL ANNUAL REPORTS

Alberta: Annual Report of the Mines Branch of the Department of Lands and Mines of the Province of Alberta, 1945. Pp. 181, 10 × 6½. (Edmonton: King's Printer, 1946.)

Victoria: Annual Report including Gold and Mineral Statistics and Boring Records for the year 1945. *Dep. Mines, Victoria.* Pp. 24, 13 × 8½. (Melbourne: Government Printer, 1946.)

South Australia: Mining Review for the half-year ended June 30, 1945. *No.* 82, *Dep. Mines S. Australia.* Pp. 133, 9¾ × 6. (Adelaide: Government Printer, 1946.)

Puerto Rico: Report of the Bureau of Mines on the Mineral Resources of Puerto Rico—An Appendix to the Annual Report of the Bureau of Mines for the fiscal years 1939-41. Pp. 52, 9 × 6. (San Juan, P.R.: Bureau of Supplies, Printing and Transportation, 1941.)

MINING LAW

Union of South Africa: Gold and Base Metal Laws Being the Transvaal Act No. 35, 1908 (Gold Law) with Amending Statutes, the Orange Free State Metals Mining Act, 1936, the Base Minerals Amendment Act, 1942, and the Natural Oil Act, 1942. By M. Nathan. Pp. 335, 9¾ × 6½. (Johannesburg: Hortors Limited, 1944.) Price 44*s*.

Union of South Africa: Act to Promote Research into Deep Level Mining and in Matters incidental thereto, for that Purpose to Establish a Deep Level Mining Research Institute. Act No. 27, 1946. *Union Gazette Extraordinary*, 1946, **144**, No. 3660, x-xvii.

Union of South Africa: Act to Amend, Consolidate and Extend the Law relating to Miners' Phthisis. [The Silicosis Act, 1946.] Act No. 47, 1946. *Union Gazette Extraordinary*, 1946, **145**, No. 3676, ii-cxxi. [In English and Afrikaans.]

COMMERCIAL INTELLIGENCE

Metal Industry Handbook and Directory, 1946. Pp. 484, 8¾ × 6. (London: The Louis Cassier Co., Ltd., 1946.)

Minerals for Chemical and Allied Industries—A Review of Sources, Uses and Specifications. By S. J. Johnstone. *Industr. Chem. Chem. Mfr.*, 1946, **22**, No. 259, 477-482; No. 260, 548-554; No. 261, 573-578.

Minerals Yearbook, 1944. Pp. 1636, 9¼ × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price $3.00 (18*s*.).

Statistics of the Iron and Steel Industry of the United Kingdom for the year 1945. Pp. 60, 9 × 6¼. (London: British Iron and Steel Federation, 1946.)

Iron and Steel Industry. Reports by the British Iron and Steel Federation and the Joint Iron Council to the Minister of Supply. *Ministry of Supply*. Pp. 107, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 1*s*. 6*d*.

The Chamber of Mines of Rhodesia (Incorporated): Report of the Executive Committee for the year ended December 31, 1945. Pp. 8, 10¾ × 8. (Bulawayo: Rhodesian Printing and Publishing Company, Ltd., 1946.)

Transvaal Chamber of Mines: Proceedings at the Annual General Meeting held in Johannesburg, Monday, March 25, 1946. Pp. 17, 9¼ × 7¼. (Johannesburg: Transvaal Chamber of Mines, 1946.)

Mineral Trade Notes. *U.S. Bur. Mines*, 1946, **22**, Nos. 5 and 6; **23**, No. 2; 44, 51 and 49 pp. respectively, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

GEOLOGY AND MINERAL RESOURCES

Tanganyika: Mineral Resources Pamphlets Nos. 1-42. *Geol. Div., Dep. Lds. Mines, Tanganyika*. 2 vols., 13½ × 8½. (Dar es Salaam: Department of Lands and Mines, 1944 and 1946.)

The North-eastern Portion of the Timagani Lake Area. By W. W. Moorhouse. *Ann. Rep. Ontario Dep. Mines*, 1942, **51**, Pt. 4, 1-46, and map (1946).

Bureau of Mineral Resources, Geology and Geophysics [Australia]. *Chem. Engng. Min. Rev.*, 1946, **38**, No. 453, 321-322. [Description of organisation and function.]

Mining in New Zealand. Pp. 12, 10 × 6¼. (Wellington: Government Printer, 1945.) Extract from the *New Zealand Official Year Book*, 1945.

Mineral Investigations of the Geological Survey in Alaska in 1943 and 1944. By J. C. Reed. *Bull. No.* 947-A, *U.S. Geol. Surv.* Pp. 6, 9 × 5¾. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 5 cents.

Minerals Review of Latin America, 1939-44. *Foreign Minbr. Surv.*,

1945, **2**, No. 4, *U.S. Bur. Mines.* Pp. 112, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

The Mineral Resources of China. By V. C. Juan. *Econ. Geol.*, 1946, **41**, No. 4, Pt. 2, *Supplement*, 339-474, 10 × 7. (Urbana, Illinois: The Economic Geology Publishing Company, 1946.) Price 75 cents.

Mineral Resources of Japan. *Foreign Miner. Surv.*; 1945, **2**, No. 5, *U.S. Bur. Mines.* Pp. 118, 10½ × 8, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.)

PROSPECTING AND MINING METHODS

(*See also under Metals and Non-Metals.*)

A Study of Fault Determinations by Geophysical Methods in the Fluorspar Areas of Western Kentucky. By F. W. Lee and S. J. Hemberger. *Rep. Invest. No.* 3889, *U.S. Bur. Mines.* Pp. 27, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Standardised Tests for Determining the Physical Properties of Mine Rock. By L. Obert, S. L. Windes and W. I. Duvall. *Rep. Invest. No.* 3891, *U.S. Bur. Mines.* Pp. 67, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Explosives-Handling Practices at the Mines of the Anaconda Copper Mining Co. at Butte, Mont. By E. F. Courtney and J. A. Johnson. *Inform. Circ. No.* 7356, *U.S. Bur. Mines.* Pp. 13, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Active List of Permissible Explosives and Blasting Devices Approved previous to December 31, 1945. By J. E. Tiffany and Z. C. Gaugler. *Rep. Invest. No.* 3910, *U.S. Bur. Mines.* Pp. 20, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Mining Electrical Machinery. Intrinsically Safe Remote Control Circuits. *M.F.P. Safety Circ. No.* 148. Pp. 2, 9½ × 6. (London: Ministry of Fuel and Power, 1946.)

Intrinsic Safety of Electrical Apparatus. The Minimum Igniting Current in Relation to Circuit Constants. By G. Allsop, E. M. Guénault and A. D. I. Nichol. *Safety in Mines Res. Bd. Paper No.* 104, *Ministry of Fuel and Power.* Pp. 15, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 6*d*.

Coal-Mine Explosions and Coal- and Metal-Mine Fires in the United States during the fiscal year ended June 30, 1945. By D. Harrington, W. J. Fene and H. B. Humphrey. *Inform. Circ. No.* 7359, *U.S. Bur. Mines.* Pp. 22, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Gold Coast Colony: Report on Silicosis and Tuberculosis among Mineworkers in the Gold Coast. By A. J. Murray and J. A. Crocket. Pp. 59, 13 × 8¼. (Accra: Government Printing Department, 1946.) Price 4*s*.

Union of South Africa: Report upon the work of the Miners' Phthisis Medical Bureau for the three years ended July 31, 1944. Pp. 52, 12¾ × 8. (Pretoria: Government Printer, 1946.) Price 7*s*. 6*d*.

A Plan for Training Mine Officials in Rescue Organisation and Disaster Prevention. By E. R. Maize and J. V. Berry. *Inform. Circ. No.* 7353, *U.S. Bur. Mines.* Pp. 13, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

CONCENTRATION AND METALLURGY

(*See also under Metals and Non-Metals.*)

Routine Quantitative Analysis by X-Ray Diffraction. 1. Photometric Procedure. 2. Analytical Method. By J. W. Ballard and H. H. Schrenk. *Rep. Invest. No.* 3888, *U.S. Bur. Mines.* Pp. 10, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

METALS

Aluminium and Bauxite

The Recovery of Metal and other Valuable Products from Aluminum Dross. By O. C. Garst, F. Fraas, W. M. Mahan, D. D. Blue and L. Fink. *Rep. Invest. No.* 3874, *U.S. Bur. Mines.* Pp. 43, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Aluminium and Bauxite. By D. E. Gardner and N. H. Ludbrook. *Summ. Rep. No.* 27, *Min. Res. Australia.* Pp. 21, 13 × 8½, with graphs and map. (Canberra: Department of Supply and Shipping, 1946.).

Fluorite (Fluorspar) and Cryolite. By H. B. Owen, N. H. Fisher and N. H. Ludbrook. *Summ. Rep. No.* 6, *Min. Res. Australia.* Pp. 21, 9½ × 6. (Canberra: Government Printer, 1946.)

Concentration of Bauxite for Milling in the 50-ton Bureau of Mines Pilot Plant, Bauxite, Ark. By S. M. Runke and R. G. O'Meara. *Rep. Invest. No.* 3909, *U.S. Bur. Mines.* Pp. 25, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Antimony

Antimony. By N. H. Fisher and N. H. Ludbrook. *Summ. Rep. No.* 3, *Min. Res. Australia.* Pp. 19, 9½ × 6, with tables and map. (Canberra: Government Printer, 1946.)

Quicksilver—Antimony Deposits of Huitzuco, Guerrero, Mexico. By J. F. McAllister and D. H. Ortiz. *Bull. No.* 946-B, *U.S. Geol. Surv.* Pp. 23, 9 × 5¾, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 75 cents.

San José Antimony Mines near Wadley, State of San Luis Potosí, Mexico. By D. E. White and J. Gonzáles R. *Bull. No.* 946-E, *U.S. Geol. Surv.* Pp. 23, 9 × 5¾, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 40 cents.

Arsenic

Arsenic. By D. E. Gardner and N. H. Ludbrook. *Summ. Rep. No.* 22, *Min. Res. Australia.* Pp. 24, 13 × 8½, with graph and map. (Canberra: Department of Supply and Shipping, 1946.)

Beryllium

The Lyndoch Beryl Deposit—Only Commercial Deposit in Eastern Canada. By D. C. McLaren. *Canad. Min. J.*, 1946, **67**, No. 9, 857-862.

Mica and Beryl Examination and Exploration in Cleburne, Randolph, Clay, Coosa, Chilton, Tallapoosa, and Lee Counties, Ala. By Staff, Tuscaloosa Division Mining Branch. *Rep. Invest. No.* 3905, *U.S. Bur. Mines.* Pp. 119, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Bismuth

Bismuth. By N. H. Fisher and N. H. Ludbrook. *Summ. Rep. No.* 9, *Min. Res. Australia.* Pp. 20, 13 × 8½, with graph and map. (Canberra: Department of Supply and Shipping, 1946.)

Ocorrência de Bismuto na Serra do Marão. By A. B. Ferreira and J. M. Cotelo Neiva. Pp. 7, 9¾ × 6¾. (Oporto: Emprêsa Industrial Gráfica do Porto, L. da, 1945.) [In Portuguese.]

Cadmium

Cadmium. By C. J. Sullivan and N. H. Ludbrook. *Summ. Rep. No.* 21, *Min. Res. Australia.* Pp. 9, 13 × 8½, with graph and map. (Canberra: Department of Supply and Shipping, 1946.)

Chromium

Chromite-Bearing Sands of the Southern Part of the Coast of Oregon. By A. B. Griggs. *Bull. No.* 945-E, *U.S. Geol. Surv.* Pp. 38, 9 × 5¾, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 55 cents.

Cobalt

Cobalt. By P. B. Nye and N. H. Ludbrook. *Summ. Rep. No.* 32, *Min. Res. Australia.* Pp. 14, 13½ × 8½, with table, graph and map. (Canberra: Department of Supply and Shipping, 1946.)

Columbium and Tantalum

Tantalum and Niobium. By K. R. Miles, D. Carroll and H. P. Rowledge. *Bull. No.* 3, *Min. Res. West. Australia.* Pp. 150 + xvi, 8½ × 5½, and maps. (Perth: Government Printer, 1945.)

Tantalum and Columbium. By C. J. Sullivan and N. H. Ludbrook. *Summ. Rep. No.* 19, *Min. Res. Australia.* Pp. 24, 9½ × 6. (Canberra: Government Printer, 1946.)

Copper

The Geology of the Messina Copper Mines and Surrounding Country. By P. G. Söhnge. *Geol. Surv. Mem. No.* 40, *Dep. Mines, S. Afr.* Pp. 280, 9½ × 6, and plates in separate pocket. (Pretoria: Government Printer, 1945.) Price £1 1*s.*

Mount Oxide Copper Mine, Cloncurry Field [Queensland]. By S. R. L. Shepherd. *Queensland Govt. Min. J.*, 1946, **47**, No. 534, 110-113.

" Orphan " Copper Mine, Dobbyn [Queensland]. By S. R. L. Shepherd. *Queensland Govt. Min. J.*, 1946, **47**, No. 534, 113-114.

La Pratique du Traitement Électrochimique des Minerais de Cuivre du Katanga. By E. Roger. *Mém. Inst. Roy. Colon. Belge* (8° *Collection*), 1946, **4**, No. 3. 66 pp., 9½ × 6½, and plates. (Brussels: Librairie Falk fils, Georges van Campenhout, 1946.) [In French.]

Nickel-Copper Prospect near Spirit Mountain, Copper River Region, Alaska. By J. Kingston and D. J. Miller. *Bull. No.* 943-C, *U.S. Geol. Surv.* Pp. 8, 9 × 5¾. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 10 cents.

Exploration of the El Dorado Copper Mine, El Dorado County, Calif. By R. H. Bedford. *Rep. Invest. No.* 3896, *U.S. Bur. Mines.* Pp. 5, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Gold

La Prospection et les Gisements d'Or de Demain. By R. Goloubinow. *Pub. Bur. d'Études Géol. et Min. Colon., Paris,* 1940, No. 15, 5-10.

Gisements sous Basalte au Kivu (Congo Belge). By G. Passau. *Mém. Inst. Roy. Colon. Belge* (8° *Collection*), 1946, **15**, No. 6, 24 pp., 9½ × 6½, and map. (Brussels: Librairie Falk fils, Georges van Campenhout, 1946.)

Iron and Steel

Recommendations for Phosphate Coatings as a Basis for Painting Steel. PD539, *Brit. Stand. Instn. August,* 1946. Pp. 3, 8½ × 5½. (London: British Standards Institution, 1946.) Price 1*s.*

Foundry Sand Resources of South Australia. By H. S. Cornelius and H. A. Stevens. *Bull. No.* 190, *Counc. Sci. Industr. Res., Australia.* Pp. 80, 9½ × 6, and plates. (Melbourne: Government Printer, 1945.)

Lead and Zinc

Material Specification. Zinc Chrome. D.T.D.377A, April 1946. *Ministry of Supply*. Pp. 3, 11 × 8. (London: H.M. Stationery Office, 1946.) Price 1s.

The Dressing of Complex Lead-Zinc Ores. By F. B. Michell. *Mine and Quarry Engng.*, 1946, **12**, No. 5, 135-144.

Lead. By N. H. Fisher and N. H. Ludbrook. *Summ. Rep. No.* 23, *Min. Res. Australia*. Pp. 34, 13½ × 8½, with graphs and map. (Canberra: Government Printer, 1946.)

Zinc. By N. H. Fisher and N. H. Ludbrook. *Summ. Rep. No.* 33, *Min. Res. Australia*. Pp. 21, 13½ × 8½, with graphs and map. (Canberra: Department of Supply and Shipping, 1946.)

Exploration of Zinc and Lead Ore, Phelps Lease, Jasper County, Missouri. By L. C. Brichta. *Rep. Invest. No.* 3941, *U.S. Bur. Mines*. Pp. 39, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Exploration of the New Dale Rundell Zinc Mine, Mifflin District, Iowa County, Wis. By F. C. Lincoln. *Rep. Invest. No.* 3912, *U.S. Bur. Mines*. Pp. 8, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Lithium

Lithium. By L. C. Noakes and N. H. Ludbrook. *Summ. Rep. No.* 25, *Min. Res. Australia*. Pp. 13, 13 × 8½, and map. (Canberra: Department of Supply and Shipping, 1946.)

Magnesium

Magnesium—Magnesite, Dolomite, etc. By F. Canavan, N. H. Fisher and N. H. Ludbrook. *Summ. Rep. No.* 11, *Min. Res. Australia*. Pp. 36, 13 × 8½, with graphs and maps. (Canberra: Department of Supply and Shipping, 1946.)

Manganese

Manganese. By C. L. Knight and N. H. Ludbrook. *Summ. Rep. No.* 7, *Min. Res. Australia*. Pp. 25, 13½ × 8½, with graphs and map. (Canberra: Department of Supply and Shipping, 1946.)

Mercury

Quicksilver—Antimony Deposits of Huitzuco, Guerrero, Mexico. By J. F. McAllister and D. H. Ortiz. *Bull. No.* 946-B, *U.S. Geol. Surv.* Pp. 23, 9 × 5¾, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 75 cents.

Molybdenum

Molybdenum. By N. H. Fisher and N. H. Ludbrook. *Summ. Rep. No.* 8, *Min. Res. Australia*. Pp. 25, 9½ × 6., (Canberra: Government Printer, 1946.)

Nickel

The Romance of Nickel. Pp. 56, 9½ × 6½. (Copper Cliff, Ontario: The International Nickel Company of Canada, Limited, 1946.)

The Operations and Plants of International Nickel Company of Canada, Limited. By the Executive and Operating Staffs. *Canad. Min. J.*, 1946, **67**, No. 5, 309-556.

Nickel-Copper Prospect near Spirit Mountain, Copper River Region, Alaska. By J. Kingston and D. J. Miller. *Bull. No.* 943-C, *U.S. Geol. Surv.* Pp. 8, 9 × 5¾. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 10 cents.

Exploration of Spirit Mountain Nickel Prospect, Canyon Creek, Lower Copper River Region, Alaska. By H. C. Pierce. *Rep. Invest. No.* 3913, *U.S. Bur. Mines.* Pp. 8, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Platinum Metals

Possibilidade de Ocorrência de Platina no Distrito de Bragança. By J. M. Cotelo Neiva. Pp. 11, 9¾ × 6¾. (Oporto: Emprêsa Industrial Grâphica do Porto L. da, 1945.) [In Portuguese.]

Radium Minerals

United Kingdom: Sixteenth Annual Reports of the National Radium Trust and Radium Commission, 1944-45. Pp. 71, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 1s. 3*d*.

The Eldorado Enterprise. By Members of the Staff. *Canad. Min. Metall. Bull.* (*Trans. Sec.*), 1946, No. 413, 423-438.

Rare Earth Minerals

Technology and Uses of Monazite Sand. By R. P. Hammond. *A.I.M.E. Tech. Pub. No.* 2037, 5 pp. *Min. Tech.*, 1946, **10**, No. 4.

Tin

Geology of the Plateau Tinfields. *Interim Rep. No.* 1, *Geol. Surv. Dep., Nigeria.* Pp. 11, 9¾ × 7, and map. (Lagos: Government Printer, 1945.) Price 1s. 6*d*.

Jazigos Portugueses de Cassiterite e de Volframite. By J. M. Cotelo Neiva. Pp. 251, 9½ × 6½. (Lisbon: Direcção Geral de Minas e Serviços Geológicos, 1944.) [In Portuguese.]

Gisements sous Basalte au Kivu (Congo Belge). By G. Passau. *Mém. Inst. Roy. Colon. Belge* (8° *Collection*), 1946, **15**, No. 6, 24 pp., 9½ × 6½, and map. (Brussels: Librairie Falk fils, Georges van Campenhout, 1946.)

Tin and Tungsten Deposits of French Morocco. By E. T. Heck. *Econ. Geol.*, 1946, **41**, No. 4, Pt. 1, 383-389.

Investigation of the Lost River Tin Deposit, Seward Peninsula, Alaska. By H. E. Heide. *Rep. Invest. No.* 3902, *U.S. Bur. Mines.* Pp. 57, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Tungsten

Mining and Recovery of Scheelite at King Island [Tasmania]. *Chem. Engng. Min. Rev.*, 1946, **38**, No. 453, 330-338.

The Scheelite Deposits at Glenorchy, New Zealand. By J. J. Reed. *Trans. Proc. Roy. Soc. N.Z.*, 1945, **75**, Pt. 3, 371-393, and plates.

Jazigos Portugueses de Cassiterite e de Volframite. By J. M. Cotelo Neiva. Pp. 251, 9½ × 6½. (Lisbon: Direcção Geral de Minas e Serviços Geológicos, 1944.) [In Portuguese.]

Tin and Tungsten Deposits of French Morocco. By E. T. Heck. *Econ. Geol.*, 1946, **41**, No. 4, Pt. 1, 383-389.

Scheelite Deposits in the Northern Part of the Sierra de Juarez, Northern Territory, Lower California, Mexico. By C. Fries, Jun., and E. Schmitter. *Bull. No.* 946-C, *U.S. Geol. Surv.* Pp. 29, 9 × 5¾, and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 25 cents.

Tungsten Deposits of the Southern Part of Sonora, Mexico. By J. H. Wiese and S. Cardenas. *Bull. No.* 946-D, *U.S. Geol. Surv.* Pp. 28, 9 × 5¾,

and maps. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 15 cents.

Uranium

The Eldorado Enterprise. By Members of the Staff. *Canad. Min. Metall. Bull.* (*Trans. Sec.*), 1946, No. 413, 423-438.

Vanadium

Vanadium Deposits in the Otavi Mountains, South-West Africa. By C. M. Schwellnus. *Trans. Geol. Soc. S. Afr.*, 1945, **48**, 49-73.

NON-METALS

Barytes

Swaziland: Report on the Barytes Deposit on Crown Mineral Area No. 7. By A. T. M. Mehliss. *Geol. Surv. Dep., Swaziland.* Pp. 14, 12½ × 8, and maps. (Swaziland: Geological Survey Department, 1946.)

Barium (Barite or Barytes). By F. Canavan, N. H. Fisher and N. H. Ludbrook. *Summ. Rep. No.* 13, *Min. Res. Australia.* Pp. 20, 13 × 8½, with graphs and map. (Canberra: Department of Supply and Shipping, 1946.)

Mining and Marketing of Barite. By C. L. Harness and F. M. Barsigan. *Inform. Circ. No.* 7345, *U.S. Bur. Mines.* Pp. 78, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Bentonite

The Properties and Testing of Bentonite. By D. G. Beech and M. Francis. *Trans. Brit. Ceram. Soc.*, 1946, **45**, No. 4, 148-160.

Bentonite and Fuller's Earth. By N. H. Fisher and N. H. Ludbrook. *Summ. Rep. No.* 30, *Min. Res. Australia.* Pp. 17, 13 × 8½, with graph and map. (Canberra: Department of Supply and Shipping, 1946.)

Building Materials

Soils, Concrete and Bituminous Materials. A Record of a Course dealing with Airfield Construction given at the Road Research Laboratory, Department of Scientific and Industrial Research, July-August 1943. Pp. 288, 9½ × 7¼. (London: H.M. Stationery Office, 1946.) Price 10*s.*

Roadstone: Geological Aspects and Physical Tests. By J. Phemister, E. M. Guppy, A. H. D. Markwick and F. A. Shergold. *Road Res. Spec. Rep. No.* 3, *Dep. Sci. Industr. Res.* Pp. 42, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 9*d.*

Clay and Ceramics

Diagnostic Criteria for Clay Minerals. By W. F. Bradley. *Rep. Invest. No.* 115, *Illinois State Geol. Surv.* Pp. 9, 10 × 6¾. (Urbana, Illinois: Geological Survey Division, 1946.) Reprinted from *Amer. Mineral*, 1945, **30**, 704-713.

Minerals of the Montmorillonite Group. Their Origin and Relation to Soils and Clays. By C. S. Ross and S. B. Hendricks. *Prof. Pap. No.* 205-B, *U.S. Geol. Surv.* Pp. 57, 11½ × 9¼. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1945.) Price 35 cents.

Report of the Enquiry on the Ball-Clay Industry. *Board of Trade.* Pp. 14, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 3*d.*

Coal, etc.

Fuel Abstracts. Compiled by Intelligence Section, Fuel Research Station, Greenwich, London, S.E.10. *Fuel Res., Dep. Sci. Industr. Res.*, 1946, **8**,

Nos. 4, 5 and 6, 4, Nos. 1/2 and 3. Pp. 123 + xvii, xxiv + 222, 193 + xvii, 229 + xxiv and 80 + ix respectively, 12½ × 8. (London: Department of Scientific and Industrial Research, 1946.) Not for sale.

Tests of Bituminous-Anthracite Mixtures on Industrial Stokers. By J. F. Barkley, L. R. Burdick and R. Wiggers. *Rep. Invest. No.* 3916, *U.S. Bur. Mines.* Pp. 16, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Gasification of Lignite and Sub-bituminous Coal. Progress Report for 1944. By V. F. Parry and others. *Rep. Invest. No.* 3901, *U.S. Bur. Mines.* Pp. 59, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Blending Properties of Low- and Medium-Volatile Coals as determined in the BM-AGA Apparatus. By D. A. Reynolds and J. D. Davis. *Rep. Invest. No.* 3936, *U.S. Bur. Mines.* Pp. 20, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Physical and Combustion Characteristics of Packaged Fuel containing Anthracite Fines. By L. D. Schmidt, W. T. Reid, W. Seymour and J. W. Myers. *Rep. Invest. No.* 3882, *U.S. Bur. Mines.* Pp. 35, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Agreement for the Establishment of the European Coal Organisation, London, January 4, 1946. *Treaty Series No.* 1 (1946). Pp. 8, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 2*d.*

United Kingdom: Coal Industry Nationalisation Act, 1946. 9 & 10 Geo. 6. Ch. 59. Pp. 68, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 1*s.*

United Kingdom: Report of the Coal Commission for the year ended March 31, 1946. *Ministry of Fuel and Power.* Pp. 3, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 1*d.*

Coal Mining Industry Annual Statistical Statement of the Costs of Production, Proceeds and Profits of the Coal Mining Industry for the year 1945. *Ministry of Fuel and Power.* Pp. 9, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 2*d.*

Rapid Survey of Coal Reserves and Production—First Appraisal of Results. *Surv. Pap. No.* 58, *Fuel Res., Dep. Sci. Industr. Res.* Pp. 23, 9½ × 6, and tables. (London: H.M. Stationery Office, 1946.) Price 9*d.*

The Extraction of Ester Waxes from British Lignite and Peat. By C. M. Cawley and J. G. King. *Tech. Pap. No.* 52, *Fuel Res., Dep. Sci. Industr. Res.* Pp. 29, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 6*d.*

Forest of Dean Coalfield Regional Survey Report. *Ministry of Fuel and Power.* Pp. 58, 9½ × 6. (London: H.M. Stationery Office, 1946.) Price 1*s.* 3*d.*

Corundum

Exploration of the Blue Metal Corundum Property, Douglas County, Nev. By E. O. Binyon. *Rep. Invest. No.* 3895, *U.S. Bur. Mines.* Pp. 7, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Diatomite

Diatomite. By I. Crespin, F. Canavan and N. H. Ludbrook. *Summ. Rep. No.* 12, *Min. Res. Australia.* Pp. 22, 13 × 8½, with plate, graph and map. (Canberra: Department of Supply and Shipping, 1946.)

Dolomite

Magnesium—Magnesite, Dolomite, etc. By F. Canavan, N. H. Fisher and N. H. Ludbrook. *Summ. Rep. No.* 11, *Min. Res. Australia.* Pp.

36, 13 × 8½, with graphs and maps. (Canberra: Department of Supply and Shipping, 1946.)

Felspar

Felspar (including Cornish Stone). By F. Canavan, N. H. Fisher and N. H. Ludbrook. *Summ. Rep. No.* 14, *Min. Res. Australia.* Pp. 19, 13½ × 8½, with graphs and map. (Canberra: Department of Supply and Shipping, 1946.)

Fluorspar

Fluorite (Fluorspar) and Cryolite. By H. B. Owen, N. H. Fisher and N. H. Ludbrook. *Summ. Rep. No.* 6, *Min. Res. Australia.* Pp. 21, 9½ × 6. (Canberra: Government Printer, 1946.)

Concentration of Fluorite from Metals Reserve Company Stock Piles. By M. M. Fine, W. A. Calhoun and R. G. O'Meara. *Rep. Invest. No.* 3893, *U.S. Bur. Mines.* Pp. 13, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Exploration of the Packard Fluorspar Property, Gila County, Ariz. By J. B. Cummings. *Rep. Invest. No.* 3880, *U.S. Bur. Mines.* Pp. 7, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Exploration of the White Eagle Fluorspar Mine, Cooks Peak Mining District, Grant County, N. Mex. By J. H. Soulé. *Rep. Invest. No.* 3903, *U.S. Bur. Mines.* Pp. 5, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Exploration of Eagle Mountain Fluorspar Deposits, Hudspeth County, Tex. By W. E. Dennis. *Rep. Invest. No.* 3878, *U.S. Bur. Mines.* Pp. 11, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Fuller's Earth

Bentonite and Fuller's Earth. By N. H. Fisher and N. H. Ludbrook. *Summ. Rep. No.* 30, *Min. Res. Australia.* Pp. 17, 13 × 8½, with graph and map. (Canberra: Department of Supply and Shipping, 1946.)

Gemstones

Jewels and Stones for Industrial Purposes. By H. P. Rooksby. *J. Roy. Soc. Arts*, 1946, **94**, No. 4722, 508-525.

Graphite

Graphite. By C. L. Knight and N. H. Ludbrook. *Summ. Rep. No.* 5, *Min. Res. Australia.* Pp. 23, 13 × 8½, with graph and map. (Canberra: Department of Supply and Shipping, 1946.)

Gypsum

Billingham Mine. By G. E. Stewart. *Bull. Instn. Min. Metall., Lond.*, 1946, No. 480, 11 pp., and map.

Magnesite

Magnesium—Magnesite, Dolomite, etc. By F. Canavan, N. H. Fisher and N. H. Ludbrook. *Summ. Rep. No.* 11, *Min. Res. Australia.* Pp. 36, 13 × 8½, with graphs and maps. (Canberra: Department of Supply and Shipping, 1946.)

Mica

Mica and Beryl Examination and Exploration in Cleburne, Randolph, Clay, Coosa, Chilton, Tallapoosa, and Lee Counties, Ala. By Staff, Tusca-

loosa Division Mining Branch. *Rep. Invest. No.* 3905, *U.S. Bur. Mines.* Pp. 119, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Exploration of the Avon Mica District, Latah County, Idaho. By G. C. Reed. *Rep. Invest. No.* 3898, *U.S. Bur. Mines.* Pp. 23, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Exploration of the Elk Mountain Mica Deposit, San Miguel County, N. Mex. By R. J. Holmquist. *Rep. Invest. No.* 3921, *U.S. Bur. Mines.* Pp. 7, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Petroleum, etc.

International Petroleum Trade. *Int. Petrol. Tr.*, 1946, **15**, Nos. 6, 7 and 8, *U.S. Bur. Mines.* Pp. 14, 20 and 27 respectively, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Asphalts and Allied Substances: Their Occurrence, Modes of Production, Uses in the Arts and Methods of Testing. By Herbert Abraham. Vol. 1, pp. xviii + 887; Vol. 2, pp. viii + 889-2142, 9½ × 6¼. (New York: D. Van Nostrand Company, Inc.; London: Chapman & Hall, Ltd., 1945.) Price 100s. the two volumes.

Essentials of Petroleum: A Key to Oil Economics. By P. H. Frankel. Pp. xv + 173, 9 × 5¾. (London: Chapman & Hall, Ltd., 1946.) Price 15s.

Oil and Petroleum Year Book, 1946. Compiled by W. E. Skinner. Pp. 200, 8½ × 5½. (London: Walter E. Skinner, 1946.) Price 15s.

European Shale-Treating Practice. By W. W. Odell and E. L. Baldeschwieler. *Inform. Circ. No.* 7348, *U.S. Bur. Mines.* Pp. 70, 10½ × 8. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.)

Petroleum. *Rep. No.* 17, *War Changes in Industry Series, U.S. Tariff Commission.* Pp. 152, 9 × 6. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1946.) Price 30 cents.

Marine Pool, Madison County—A New Type of Oil Reservoir in Illinois. By H. A. Lowenstam and E. P. Dubois. *Rep. Invest. No.* 114, *Illinois State Geol. Surv.* Pp. 30, 10 × 6¾. (Urbana, Illinois: State Geological Survey Division, 1946.)

Phosphates

Phosphates. By T. D. Dimmick and N. H. Ludbrook. *Summ. Rep. No.* 29, *Min. Res. Australia.* Pp. 23, 13½ × 8½, with tables, graphs and map. (Canberra: Department of Supply and Shipping, 1946.)

Pigments

Pigment Minerals. By C. J. Sullivan and N. H. Ludbrook. *Summ. Rep. No.* 24, *Min. Res. Australia.* Pp. 30, 13 × 8½, with graph and maps. (Canberra: Department of Supply and Shipping, 1946.)

Refractories

Sillimanite, Kyanite, etc. By L. C. Noakes and N. H. Ludbrook. *Summ. Rep. No.* 26, *Min. Res. Australia.* Pp. 14, 13 × 8½, with graph and maps. (Canberra: Department of Supply and Shipping, 1946.)

Sulphur

Sulphur (including Pyrite and other Sulphur-bearing Minerals.) By T. D. Dimmick and N. H. Ludbrook. *Summ. Rep. No.* 31, *Min. Res.*

Australia. Pp. 22, $13\frac{1}{4} \times 8\frac{1}{4}$, with graphs and map. (Canberra: Department of Supply and Shipping, 1946.)

Water Supply

A Geochemical Survey of the Underground Water Supplies of the Union of South Africa with Particular Reference to their Utilisation in Power Production and Industry. By G. W. Bond. *Geol. Surv. Mem. No.* 41, *Dep. Mines, S. Afr.* Pp. 216, $9\frac{1}{2} \times 6$, and maps. (Pretoria: Government Printer, 1946.) Price 10*s*.

EMPIRE EDUCATIONAL FACILITIES

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NOTES

Exhibition Galleries.—*Visit of H. M. Queen Mary.*—On Monday, October 21, Queen Mary honoured the Imperial Institute with a visit at 3-30 p.m. Her Majesty spent an hour in the East and North Galleries examining the exhibits in the India, Burma, and Ceylon Courts—the Aden Court, which is under reconstruction—the Court of the Union of South Africa, and those of the African and Mediterranean Dependencies.

Her Majesty was particularly interested in the new exhibits recently installed, as, for example, the two new vanishing dioramas in the India Court; the new method of fluorescent lighting; the Bauchi paintings in the West Africa Court; and new exhibits projected for South Africa, Cyprus, Malta, and Gibraltar.

The Director of the Institute and the Curator of the Exhibition Galleries escorted Her Majesty through both Galleries and explained the exhibits.

Staff.—During the six months, July to December, 1946, the Staff situation tended to become more satisfactory. The Assistant Curator, Mr. F. Boulton, was released by the Rubber Control Board and resumed duty in the Galleries early in July; and in September the demobilisation of one of the Manual Attendants brought the number in that category up to the establishment figure of four.

The demobilisation of some of the labour staff, who also act as uniformed attendants, and the engagement of some new men have enabled the opening time of the Galleries to the general public to be advanced as from July 1. Thus the Galleries are now open daily, except for Sundays and Bank Holidays, from 10 a.m. to 4-30 p.m. and the Cinema from 3-30 to 4-15 p.m., with an extra performance 2-15 to 3 p.m. on Saturdays.

There is still, however, a shortage of two Exhibition Officers and one Guide Lecturer, a situation which is delaying the installation of new exhibits and the re-organisation of existing ones.

Women's Voluntary Services.—Reversion to more normal hours and to peace-time arrangements for the patrol of the Galleries means that the Institute has bidden regretful farewells to the ladies of the

Women's Voluntary Services, whose most helpful co-operation during the difficult war years has been of the greatest value. A suitable letter of thanks for their greatly appreciated services was sent to each of them and only one, Miss Cresswell, now remains. She asked, and received, permission to carry on at her usual post at the Central Stand because of her keen interest in the Galleries and in our numerous school visitors.

Attendance.—The earlier opening of the Galleries led to an immediate rise in the attendance figures and the position is extremely satisfactory. In all 77,775 persons visited the Galleries between July 1 and December 31, 1946, including 337 organised parties. Comparative figures for January-June, 1946 were 29,718 and 262. There was a considerable falling off in attendances during October and November 1946, as a result of the great popularity of the "Britain Can Make It" Exhibition at the Victoria and Albert Museum near by.

Reports by Schools and others.—In October a form of report on visits by those in charge of school and other parties was instituted. It is hoped that the "General remarks" on this form and the answer to the question "What did your pupils learn from their visit?" may be of value in planning new exhibits and re-arranging existing ones.

New Exhibits Received

Uganda.—Specimens of all the minerals known to exist in Uganda were received during the half-year under review and enabled the appropriate display to be greatly improved and brought up to date.

Aden.—A piece of ambergris found at Aden by Mr. R. C. Davey and kindly lent by him to the Exhibition Galleries has been placed in the Aden Court.

India.—A handsome gift by Mrs. I. M. Christie has been placed with the jute display in the India Court. This is a twelve-inch silver model of an Indian jute "flat," a type of water-borne warehouse used for the conveyance of jute on the Ganges and other rivers of Bengal.

Two of the dissolving pictures referred to in this Bulletin (1946, **44**, 175) have now been completed and are attracting attention in the India Court. One shows cotton-pickers at work in a field of Indian cotton, the scene changing to the sales counter in a bazaar, where locally-made cotton fabrics are displayed for sale. In the other picture a field of tobacco gradually dissolves and in its place appears a group of Indians in a bazaar café, all smoking tobacco in various ways—cigarettes, hookah, cheroots and so on.

The display of twenty-six Indian minerals mentioned in this Bulletin (*loc. cit.*) has now been completed.

Burma.—Three interesting additions have been made to the Burma Court. In the first place, the diorama of the Ananda Temple

at Pagan, referred to in this BULLETIN (*loc. cit.*), has been completed and placed in the Burma Court. It is the work of Mr. Ernest Whatley and presents a most attractive view of one of Burma's oldest and best-known Temples. The second is a typical dress as worn by a hill-woman of the Shan States; this was very kindly given to the Institute by Lady Dorman-Smith, wife of the war-time Governor of Burma. The third, a presentation by Mr. A. L. M. Lefroy, is a Burmese "dah" or sword with a steel blade, silver hilt, and silver-alloy scabbard. This dah was specially made for an exhibition in Burma and is a splendid example of Burmese craftsmanship. The whole of the blade on both sides is covered with writing and figures in silver inlay, telling and illustrating the following legendary story of the re-incarnation of Buddha:

"THE STORY OF SANDAGOK"

At an early age Sandagok was abandoned in a forest by his parents, a King and Queen who had been driven from their thrones by a usurper. A kind hunter found Sandagok wandering among the trees and, taking pity upon his wretched state, adopted him and brought him up.

By reason of his royal parentage the boy was very clever and was physically agile and strong. Even as a boy he showed unusual qualities of leadership; when disputes arose among his fellow cowherds he was invariably asked to intervene and settle them. His tact and cleverness, combined with his great energy, won him the respect of all in the forest.

One day a Brahmin, who tutored the Princes of the Kings for their holy responsibilities, discovered Sandagok. At once the Brahmin recognised the princely qualities which distinguished him from his fellows. The Brahmin, realising how much credit would accrue to himself by having such a talented yet unknown genius as his pupil, begged the hunter, the boy's foster-father, to let him look after Sandagok. So the poor rustic cowboy was taken from his sylvan surroundings and placed in a school in the royal capital where young Princes were learning statecraft under the Brahmin's tutelage. Here again the unlettered cowboy outshone the other boys in all arts and crafts. Not only was he their superior in archery and fencing, but he was also mentally agile and especially quick in acting upon the vaguest hints.

Now, among the youths studying at the Brahmin's school was a Prince, the son of the usurper who had banished Sandagok's parents. The Brahmin had a vague suspicion that his clever new pupil was in fact the offspring of the unfortunate ex-King and Queen. To confirm his suspicions he decided one day to test the intelligence of the two boys, whose parents were still enemies. One day, while Sandagok was asleep with a string of pearls round his neck, the Brahmin asked the usurper's son to remove the precious ornament from the sleeper's neck without waking the

sleeper or cutting the string. After racking his brains the young Prince gave the problem up. Next day, while the usurper's son was himself asleep with the same necklace round his neck, Sandagok was asked by his tutor to do the same thing and, immediately taking the hint, cut off the sleeper's head and picked up the necklace. He had neither aroused the sleeper nor cut the string.

In accordance with an ancient custom, which decreed that one who killed a Prince or King automatically inherited the deceased's estate, Sandagok was soon afterward proclaimed King."

Nigeria.—The West Africa Court has benefited by the receipt of a number of excellent photographs illustrating various styles of hairdressing in vogue amongst the women and girls of Nigeria. These were sent to the Galleries through the good offices of Miss G. Plummer, Assistant Director of Education in Nigeria, and are being used as a background to what will eventually be a display dealing generally with personal adornment in West Africa.

A very fine set of photographs and a collection of cooking utensils, also from Miss Plummer, have been incorporated in a new story exhibit describing in considerable detail the day's meals of a typical West African family from breakfast to supper.

New Exhibits Projected

The cessation of hostilities has permitted Dominion and Colonial authorities to turn their thoughts toward the problems of peace and particularly to the requirements of trade within the Empire. One result has been a widespread desire to bring the various Empire Courts of the Exhibition Galleries up to date and to incorporate displays of new industries which, established under the stimulus of war, will now be carried on for more peaceful purposes. There is being initiated, therefore, what will eventually amount to a re-organisation of almost the whole of the Galleries. The following paragraphs relate to some of those Courts in connection with which plans for the re-organisation and for new exhibits are being made in consultation with the Governments concerned.

Canada.—The Canadian Court is to be re-arranged from end to end in such a way as to tell the history of the country from the early days of French settlement up to and beyond the end of the Second World War. The visitor coming in by the West Entrance will be presented with a picture of Canada and its original inhabitants just as they appeared when the white man first went there. The Red Indian of the story books; the vast herds of buffalo; the moose of the Canadian woods and the beaver of the rivers; the immense trees of the west; the lakes and rivers of the east; the limitless central prairies—all will be there, together with the Falls of Niagara and the fur-bearing animals of the ice-bound north.

Dioramas, transparencies, models, and photographs will be used, as well as actual articles and specimens to tell the story of Canada,

which will proceed, after depicting the early days and scenes, to show the opening up and development of the country step by step; the establishment of the present immense dairying industry; the commencement and progress of farming generally; the utilisation of the Prairie provinces to grow wheat to make the world's bread; the yoking of the rivers to provide electric power; the discovery and working of minerals in the Sudbury Basin and other areas; the felling of trees and the use of the timber for building and allied purposes and for paper-making; the development of the fishing and fish-preserving industries of the east and west; the pioneer work of the Hudson's Bay Company in the frozen north and the growth of the fur-trapping industry; the utilisation of the country's minerals and coal in the iron and steel, motor-car, and other manufacturing businesses; the growing of fruit in British Columbia.

The list of industries and occupations in this wealthy and progressive country would fill a large book, but all will be given a place, large or small, in the new Canadian Court, in which, when completed, the visitor will be able to survey nearly four-and-a-half centuries of the history of the Senior Dominion of the British Empire.

Union of South Africa.—A set of swing frames containing upwards of sixty up-to-date photographs of South African life and scenery has been planned for the South African Court. Other new photographs will be used to replace older ones in the ostrich feather case and elsewhere. The subjects have already been selected and exhibition prints are awaited.

Southern Rhodesia.—A complete plan of improvements to the exhibits in the Southern Rhodesian Court has been prepared and submitted to the High Commissioner who has accepted and forwarded it to his Government for their approval. Details will be described in a later issue of this BULLETIN as soon as official approval has been received.

Aden.—The Aden Court, situated at the north end of the East Gallery, is to be extended and will contain some entirely new exhibits, including a diorama illustrating the local dhow-building industry.

Gibraltar.—Many changes have taken place at Gibraltar since the Court as it now exists was first installed. A new and larger model of the Rock and the harbour is to be sent from Gibraltar and it is hoped that the entrances to the galleries and to the recently-discovered limestone caves may be indicated on it.

Some new aerial photographs have already been supplied free of cost by the Royal Air Force Photographic Unit and others will come forward in due course.

One new photograph covers the historic "Ceremony of the Keys;" this has been placed over the case containing the replicas of the keys themselves, together with a brief account of the ceremony.

Western Pacific.—The importance of the two phosphate islands Nauru and Ocean island, will be stressed in a new and more elaborate

display of the deposits, showing how the phosphate is worked and how it is transported and shipped.

East Africa.—A new display for the East African Court is beginning to take shape. It is an attempt to portray four stages in the life of a typical East African, the counterpart of the British John Bull. Among such a multiplicity of tribes, all possessing different characteristics and all subject to different climatic and geographical influences, it cannot be said that any one East African is typical of the whole; the inland farmer differs from the coastal fisherman and the man of the hills from the man of the lowlands, but all in varying degrees are able to take advantage of the educational and other facilities provided by the several Colonial Governments.

The four sections of this display will trace the East African from babyhood in a native village *via* Bush and Secondary Schools to maturity, either still as a member of his own village community or as a cog, and a not unimportant one, in the machinery of progress, as a motor mechanic, a carpenter, a blacksmith, a policeman, and so on. Or he may have successfully passed through the higher grades at Makerere College and emerged as a professional man—a doctor, lawyer, architect, etc.—ready to help his own people on the road to a higher civilisation.

British Guiana as Seen by its People

Bearing the above title, an exhibition of photographs taken by members of the British Guiana Photographic Society was staged in the British Guiana Court during October and November 1946 in co-operation with the British Council to whom the collection had been consigned. It comprised over one hundred selected subjects and formed a pictorial record of everyday impressions gathered by local people from their immediate surroundings, and as such was of especial interest to the many visitors who viewed the display. Most of the photographs showed scenes in town and country and thus might be classified as scenic or topographical, but many illustrated sporting or work-a-day incidents in the life of the people themselves and threw interesting sidelights on local amusements and industries.

Of particular interest were those subjects which might be described as contemplative—close-ups showing the striking patterns made by newly-planted rice seedlings or the ordered disorder of a tangle of ripe sugar canes. But, whatever the subject, each has been handled in masterly fashion and, as the efforts of a band of amateurs —all of them citizens of British Guiana—their standard of quality would be considered a credit to any photographic exhibition in any part of the Empire.

The collection is now being shown in other centres in Great Britain under the auspices of the British Council.

Empire Lantern Slide Library.—During the six months April to September 1946, covered by this report, 24,660 lantern slides have

been issued to schools and lecturers in the United Kingdom. The details are shown below:

	April	May	June	July	Aug.	Sept.
United Kingdom . .	300	360	60	120	60	240
Canada . . .	60	180	120	180	—	1,260
Australia . . .	360	60	180	480	60	240
New Zealand . .	180	180	360	60	—	60
South Africa . .	180	180	300	180	—	120
India	540	1,260	420	420	—	660
Burma . . .	240	60	120	60	—	120
The Colonial Empire .	2,400	2,160	2,580	2,040	600	2,160
Products of the Colonial Empire. . .	120	120	420	300	—	120
General Empire Tours .	60	360	180	—	—	120
Empire History . .	180	180	180	—	60	300
	4,620	5,100	4,920	3,840	780	5,400

A new Picture Talk on Nigeria has been written by Mr. R. T. D. Fitzgerald, M.A. The purpose of the talk is to give a background of information to those interested in the work of Administrative Officers in Nigeria and other Colonial territories and to enable them to understand that the local conditions must always be studied before administrative decisions are made. The basic geographical and climatic factors are set out; the size of the population, its distribution, tribal divisions, religions, and language differences. Some of the African customs are described and reference is made to the different educational aims in Northern and Southern Nigeria. The chief occupations of the people are illustrated by the blacksmith, weaver, farmer, miner, trader, etc. The importance of agriculture and the effects of soil erosion are mentioned and finally, the daily work of a District Officer is outlined. Throughout, Mr. Fitzgerald discusses the impact of European civilisation on what was, until recently, a primitive people and the part played by the District Officer in explaining their responsibilities to the Africans, in guiding them, and in administering his area.

The Kenya Information Office has supplied the pictures and written the script of a talk entitled "The Kenya Scene." Kenya is presented as a land of great variety in her climate, her products, and her people, with very widely differing customs and ways of life. Illustrations of the white man's activity in the tea and coffee plantations, in the production of wheat, flax, pyrethrum, and sheep and dairy farms, are followed by pictures and descriptions of the African types—the Masai with his herds, the Nilotic Luo fishing in the waters of Lake Victoria, the Kikuyu peasant tilling his land. Local Government in the African reserves is illustrated and contrasts are made between the old style African huts and the modern replacements, between the age-old methods of existence of the Africans and the new occupations open to them since the white man came to Kenya.

Six new film strips have been added to the Library during this period, making a total of 32 subjects.

Central Film Library.—The demand for films continues to be heavy. The circulation figures for the months May to October are given below. As these are mainly summer months and cover the school holiday period, the figures are lower than those for the remainder of the year.

	Empire.	G.P.O.	C.O.I.	Total.
May	2,453	447	3,785	6,685
June	1,883	376	3,095	5,354
July	1,857	344	3,033	5,234
August	430	113	1,706	2,249
September	1,516	307	2,829	4,652
October	2,736	495	4,655	7,886

Messrs. Cadbury Bros., Ltd. have presented to the Library sixty-two 16 mm. prints. These are replacement copies of 7 subjects already in circulation.

We have received from South Africa House 30 prints covering 3 new subjects, and from the Agent General for Tasmania 10 prints of 2 new subjects. These five new films are all 16 mm. sound. They are:

South Africa.

Back to the Land	What Agricultural Colleges are doing in South Africa to train young men, particularly ex-service men, as farmers.
Africa No. 1	A cine-magazine— (1) An Art Gallery in Johannesburg. (2) Preparation of snake-bite serum.
Africa No. 2	A cine-magazine— (1) Fruit Growing. (2) Customs of the bush men.

Tasmania.

Isle of Many Waters	Scenic attractions of Tasmania, showing particularly its rivers.
Scenes that are Brightest	A tour of the principal towns, rivers and lakes of Tasmania.

New Films.—Among the new films which the Central Office of Information has placed in the Library are the following, dealing with the Overseas Empire:

National Capital	Life in Canberra—the planned capital and administrative centre of the Commonwealth of Australia.
Story of Omolo	Scientific principles of agriculture at Bukura College.
Tea from Nyasaland	Shows how the tea is picked, processed and shipped to Britain; how it is tasted, blended and finally packeted for sale.
Hausa Village	Life in one of the villages of the Hausa people who live in the northern part of Nigeria and who are Mohammedans.

Empire Lectures to Schools.—The Lecturing year, which corresponds with the three school terms and ends in August, has shown a further substantial increase in the number of lectures given, viz.: 3,553 lectures to 511,529 children and young people. Last year the comparative figures were 3,044 and 436,832 respectively. When it is remembered that the Empire Lectures Scheme has now been operating for over five years it may reasonably be assumed that novelty is no longer the attraction, but that the Scheme has come to be regarded by a large body of schools and Education Authorities as a valuable contribution to the geography and general study of the Empire, and that the lectures can profitably be made an integral part of normal school practice.

This conclusion was supported at the Fifth Conference of Lecturers held at the Institute last June. Mr. R. Cartwright, Headmaster of the Hounslow Heath Secondary Modern School, Hounslow, Middlesex, supported by his Geography Mistress, led a discussion on "Relating Empire Lectures to Geography Study in a Secondary Modern School." Mr. Cartwright had many interesting things to say about the methods devised for correlating the lectures with the children's own study, which generally took the form of preparation beforehand and individual expression work and discussion afterwards, but in speaking of the satisfactory results obtained, he also paid a welcome tribute to the adaptability and sympathy shown by the lecturers in their approach to the children. In connection with the expression work some really striking portfolios were exhibited to the Conference. These, composed of text and illustrative material of all kinds, had been compiled by the children and displayed a keenness and industry which were quite remarkable. The Conference was an encouragement because it demonstrated very clearly that the Empire Lectures Scheme is not only helping to encourage amongst the children a livelier and less academic approach to their studies, but that the Empire, and what it means in terms of human development, is being made real to them.

The Autumn Term has brought a greater demand for lectures than ever before, and, if the administrative and financial problems which inevitably accompany such an enterprise can be overcome, there is good prospect that the Empire Lectures Scheme will remain a powerful factor in the dissemination of Empire knowledge in a particularly receptive sphere.

Colonial Visitors.—The following is a list of officers on leave from the Colonial Empire who have visited the Institute during the six months ending November 1946:

JUNE

K. W. S. MACKENZIE, Assistant Secretary, Mauritius.
C. P. WOODHOUSE, Master, Achimota College, Gold Coast.

JULY

C. B. BISSET, Deputy Director, Geological Survey, Uganda.
R. COULTHARD, Senior Veterinary Officer, Nigeria.
C. E. DONOVAN, Deputy Director of Education, Kenya.
. W. D. GOODBAN, Agricultural Officer, Nigeria.
. H. MCNAUGHTON, Geologist, Northern Rhodesia.
). STEVENSON, Conservator of Forests, Gold Coast.
. M. S. USHER-WILSON, Agricultural Officer, Nigeria.
J. R. WAY, Chief Geologist, Swaziland.

AUGUST

Miss E. M. BAKER, Education Officer, Nigeria.
T. BELL, Senior Agricultural Officer, Palestine.
V. E. GALE, Agricultural Officer, Nigeria.
G. W. LINES, Principal Agricultural Officer, Sierra Leone.
J. F. NICOLL, Colonial Secretary, Fiji.
C. H. REDHEAD, Education Officer, Kenya.
W. SIMPSON, Principal, Education Department, Nigeria.
F. SMITHIES, Education Officer, Nigeria.
R. C. S. STANLEY, C.M.G., O.B.E., Colonial Secretary, Gibraltar.
R. B. WARNER, Agricultural Officer, Nigeria.

SEPTEMBER

D. L. BLUNT, Director of Agriculture, Kenya.
J. R. BROWN, Agricultural Officer, Nigeria.
R. J. HARVEY, Director of Education, Zanzibar.
F. B. HIGGINS, Chief Inspector of Mines, Gold Coast.
J. HOSKINS, Acting Chief Inspector, Education Service, Nigeria.
G. G. S. HUTCHINSON, Education Officer and Public Information Officer, Kenya.
C. W. LYNN, Senior Agricultural Superintendent, Gold Coast.
G. K. ROTH, Assistant Colonial Secretary, Fiji.
E. G. SHRUBBS, Principal, Secondary School, Aden.
W. H. THORP, Senior Education Officer, Nigeria.
J. S. WEBB, Geological Survey, Nigeria.
Miss A. E. WEST, Education Officer, St. Helena.

OCTOBER

J. C. ANDERSON, District Officer, Gold Coast.
R. H. ARDILL, Public Relations Officer, Mauritius.
E. BEAUMONT, Senior Veterinary Officer, Kenya.
F. S. DANKS, Assistant Conservator of Forests, British Guiana.
B. H. EASTER, C.M.G., C.B.E., Director of Education, Jamaica.
Colonel T. T. GILBERT, Assistant Director of Education, Gold Coast.
G. C. GREEN, M.B.E., Administrator of Grenada.
Sir JOHN ADAMS HUNTER, K.C.M.G., Governor, British Honduras.
T. S. JERVIS, Agricultural Officer, Tanganyika Territory.
A. R. MELVILLE, Entomologist, Kenya.
M. A. MOLLOY, Senior Veterinary Officer, Tanganyika Territory.
C. L. RICE, Educational Officer, Sierra Leone.
J. A. R. STOYLE, Assistant Government Chemist, Nigeria.
D. H. URQUHART, Director of Agriculture, Gold Coast.
H. W. T. WEBB, Agricultural Officer, Nyasaland.

NOVEMBER

J. G. ALLAN, Public Information Officer, Nicosia, Cyprus.
H. G. CLARKE, Inspector of Schools, Bechuanaland.
R. DAY, Education Officer, Nigeria.
P. D. L. GUILBRIDE, Veterinary Officer, Northern Rhodesia.
J. H. HARRIS, Metallurgist, Geological Department, Tanganyika Territory.
C. HARVEY, Director of Agriculture, Fiji.
R. R. E. JACOBSON, Senior Geologist, Nigeria.
Major-General Sir JOHN KENNEDY, K.B.E., C.B., M.C., Governor-designate, Southern Rhodesia.
E. LAWRENCE, Senior Agricultural Officer, Nyasaland.

J. H. McGregor, Tobacco Officer, Tanganyika Territory.
Dr. S. J. Saint, C.M.G., O.B.E., Director of Agriculture, Barbados.
Miss L. M. Seaton, Mistress, European Education, Northern Rhodesia.
Sir John V. W. Shaw, C.M.G., Governor, Trinidad.

All Dominion, Indian, Burmese and Colonial Officers, as well as private residents from the Overseas Empire, who may be visiting London, are cordially invited to come to the Institute to see the Exhibition Galleries and to discuss with the Director and his staff, scientific and technical problems in which they may be interested.

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Scientific names and titles of books are printed in italics and personal names in capitals

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Hausa Village. . . . Life in one of the villages of the Hausa people who live in the northern part of Nigeria and who are Mohammedans.

Empire Lectures to Schools.—The Lecturing year, which corresponds with the three school terms and ends in August, has shown a further substantial increase in the number of lectures given, viz.: 3,553 lectures to 511,529 children and young people. Last year the comparative figures were 3,044 and 436,832 respectively. When it is remembered that the Empire Lectures Scheme has now been operating for over five years it may reasonably be assumed that novelty is no longer the attraction, but that the Scheme has come to be regarded by a large body of schools and Education Authorities as a valuable contribution to the geography and general study of the Empire, and that the lectures can profitably be made an integral part of normal school practice.

This conclusion was supported at the Fifth Conference of Lecturers held at the Institute last June. Mr. R. Cartwright, Headmaster of the Hounslow Heath Secondary Modern School, Hounslow, Middlesex, supported by his Geography Mistress, led a discussion on "Relating Empire Lectures to Geography Study in a Secondary Modern School." Mr. Cartwright had many interesting things to say about the methods devised for correlating the lectures with the children's own study, which generally took the form of preparation beforehand and individual expression work and discussion afterwards, but in speaking of the satisfactory results obtained, he also paid a welcome tribute to the adaptability and sympathy shown by the lecturers in their approach to the children. In connection with the expression work some really striking portfolios were exhibited to the Conference. These, composed of text and illustrative material of all kinds, had been compiled by the children and displayed a keenness and industry which were quite remarkable. The Conference was an encouragement because it demonstrated very clearly that the Empire Lectures Scheme is not only helping to encourage amongst the children a livelier and less academic approach to their studies, but that the Empire, and what it means in terms of human development, is being made real to them.

The Autumn Term has brought a greater demand for lectures than ever before, and, if the administrative and financial problems which inevitably accompany such an enterprise can be overcome, there is good prospect that the Empire Lectures Scheme will remain a powerful factor in the dissemination of Empire knowledge in a particularly receptive sphere.

Colonial Visitors.—The following is a list of officers on leave from the Colonial Empire who have visited the Institute during the six months ending November 1946:

JUNE

K. W. S. MACKENZIE, Assistant Secretary, Mauritius.
C. P. WOODHOUSE, Master, Achimota College, Gold Coast.

JULY

C. B. BISSET, Deputy Director, Geological Survey, Uganda.
R. COULTHARD, Senior Veterinary Officer, Nigeria.
C. E. DONOVAN, Deputy Director of Education, Kenya.
[illegible]. W. D. GOODBAN, Agricultural Officer, Nigeria.
[illegible]. H. MCNAUGHTON, Geologist, Northern Rhodesia.
[illegible]. STEVENSON, Conservator of Forests, Gold Coast.
M. S. USHER-WILSON, Agricultural Officer, Nigeria.
J. R. WAY, Chief Geologist, Swaziland.

AUGUST

Miss E. M. BAKER, Education Officer, Nigeria.
T. BELL, Senior Agricultural Officer, Palestine.
V. E. GALE, Agricultural Officer, Nigeria.
G. W. LINES, Principal Agricultural Officer, Sierra Leone.
J. F. NICOLL, Colonial Secretary, Fiji.
C. H. REDHEAD, Education Officer, Kenya.
W. SIMPSON, Principal, Education Department, Nigeria.
F. SMITHIES, Education Officer, Nigeria.
R. C. S. STANLEY, C.M.G., O.B.E., Colonial Secretary, Gibraltar.
R. B. WARNER, Agricultural Officer, Nigeria.

SEPTEMBER

D. L. BLUNT, Director of Agriculture, Kenya.
J. R. BROWN, Agricultural Officer, Nigeria.
R. J. HARVEY, Director of Education, Zanzibar.
F. B. HIGGINS, Chief Inspector of Mines, Gold Coast.
J. HOSKINS, Acting Chief Inspector, Education Service, Nigeria.
G. G. S. HUTCHINSON, Education Officer and Public Information Officer, Kenya.
C. W. LYNN, Senior Agricultural Superintendent, Gold Coast.
G. K. ROTH, Assistant Colonial Secretary, Fiji.
E. G. SHRUBBS, Principal, Secondary School, Aden.
W. H. THORP, Senior Education Officer, Nigeria.
J. S. WEBB, Geological Survey, Nigeria.
Miss A. E. WEST, Education Officer, St. Helena.

OCTOBER

J. C. ANDERSON, District Officer, Gold Coast.
R. H. ARDILL, Public Relations Officer, Mauritius.
E. BEAUMONT, Senior Veterinary Officer, Kenya.
F. S. DANKS, Assistant Conservator of Forests, British Guiana.
B. H. EASTER, C.M.G., C.B.E., Director of Education, Jamaica.
Colonel T. T. GILBERT, Assistant Director of Education, Gold Coast.
G. C. GREEN, M.B.E., Administrator of Grenada.
Sir JOHN ADAMS HUNTER, K.C.M.G., Governor, British Honduras.
T. S. JERVIS, Agricultural Officer, Tanganyika Territory.
A. R. MELVILLE, Entomologist, Kenya.
M. A. MOLLOY, Senior Veterinary Officer, Tanganyika Territory.
C. L. RICE, Educational Officer, Sierra Leone.
J. A. R. STOYLE, Assistant Government Chemist, Nigeria.
D. H. URQUHART, Director of Agriculture, Gold Coast.
H. W. T. WEBB, Agricultural Officer, Nyasaland.

NOVEMBER

J. G. ALLAN, Public Information Officer, Nicosia, Cyprus.
H. G. CLARKE, Inspector of Schools, Bechuanaland.
R. DAY, Education Officer, Nigeria.
P. D. L. GUILBRIDE, Veterinary Officer, Northern Rhodesia.
J. H. HARRIS, Metallurgist, Geological Department, Tanganyika Territory.
C. HARVEY, Director of Agriculture, Fiji.
R. R. E. JACOBSON, Senior Geologist, Nigeria.
Major-General Sir JOHN KENNEDY, K.B.E., C.B., M.C., Governor-designate, Southern Rhodesia.
E. LAWRENCE, Senior Agricultural Officer, Nyasaland.

J. H. McGregor, Tobacco Officer, Tanganyika Territory.
Dr. S. J. Saint, C.M.G., O.B.E., Director of Agriculture, Barbados.
Miss L. M. Seaton, Mistress, European Education, Northern Rhodesia.
Sir John V. W. Shaw, C.M.G., Governor, Trinidad.

All Dominion, Indian, Burmese and Colonial Officers, as well as private residents from the Overseas Empire, who may be visiting London, are cordially invited to come to the Institute to see the Exhibition Galleries and to discuss with the Director and his staff, scientific and technical problems in which they may be interested.

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Scientific names and titles of books are printed in italics and personal names in capitals